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Civil Engineering

PAVEMENT EVALUATION PROGRAM

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This instruction implements AFPD 32-10, Installations and Facilities. It outlines responsibilities, requirements, and procedures for requesting, conducting, and reporting results of pavement structural evaluations; friction characteristics evaluations; Pavement Condition Index (PCI) surveys and power check pad anchor tests. It also outlines the procedures for determining the need for runway rubber removal and provides guidance and criteria for airfield pavement Engineering Assessments (EA) and asset management. This instruction applies to all Air Force, Air Force Reserve Command (AFRC), and Air National Guard (ANG) units and personnel. This instruction may be supplemented at any level, but all direct supplements must be routed to the office of primary responsibility (OPR) of this instruction for coordination prior to certification approval. Use this guidance in the United States (U.S.) and U.S. territories in conjunction with applicable Federal, state, and local laws and regulations. Although evaluation procedures follow the same methods anywhere in the world, for installations outside the United States and its territories, compliance requirements within the Overseas Environmental Baseline Guidance Document (OEBGD) or the final governing standard (FGS) for the host country take precedence over this document. Ensure that all records created as a result of processes prescribed in this publication are maintained IAW Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of IAW Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS). The authorities to waive wing/unit level requirements in this publication are identified with a Tier (“T-0, T-1, T-2, T-3”) number following the compliance statement. See AFI 33360, *Publications and Forms Management*, for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the Publication OPR for non-tiered compliance items. Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate functional chain of command. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

SUMMARY OF CHANGES

This document has been substantially revised and a complete review is mandatory. Major changes include updates to: functional roles and responsibilities; linear segmentation guidance and the correlation to real property; comprehensive pavement evaluations master scheduling for installations; and asset management guidance.

Chapter 1

OVERVIEW

1.1. Purpose of the Program. The Air Force Pavement Evaluation Program obtains, compiles, and reports pavement strength, condition, and performance data, including data on structural, friction, and anchor capability on all airfields with present or potential Air Force missions. Pavement evaluation data gives civil engineers the information needed to actively manage base and airfield pavement systems, as well as providing operators the information they need to manage and control the airfield. They use the results of pavement evaluation studies to:

1.1.1. Determine the size, type, gear configuration, number of passes, and weight of aircraft that can safely operate from an airfield without damaging the pavement or the aircraft.

1.1.2. Develop or adjust operations usage patterns for a particular aircraft pavement system (for example, parking, apron use patterns, and taxiway routing).

1.1.3. Project or identify major maintenance or repair requirements for an airfield pavement system to support present or proposed aircraft missions. Pavement evaluations provide data used in engineering assessments and asset management. Evaluations are also a quality reference aid when designing future projects.

1.1.4. Develop and maintain airfield layout and physical property data to the section level to assist airbase mission and contingency planning functions and provide information for validation of real property records.

1.1.5. Develop and confirm design criteria.

1.1.6. Develop and justify major pavement projects and maintenance and repair (M&R) plans.

1.1.7. Enhance flight safety by implementing recommendations from friction characteristics reports, when applicable.

1.1.8. Verify that power check pad anchors can safely support aircraft engine maintenance.

1.2. Program Elements. The Air Force Pavement Evaluation Program consists of several elements:

1.2.1. Airfield pavement structural evaluations.

1.2.2. Runway friction characteristics evaluations.

1.2.3. PCI surveys for airfields and road and parking networks.

1.2.4. Power check pad (trim pad) anchor tests.

1.2.5. Pavement engineering assessments (EA).

1.2.6. Asset management.

1.3. Types of Evaluations:

1.3.1. **Airfield Pavement Structural Evaluation:** Determines the load-carrying capability of a pavement for various aircraft by testing the physical properties of the pavement system in its current condition.

1.3.2. **Runway Friction Characteristics Evaluation:** Determines the hydroplaning potential of a runway surface under standardized wet conditions.

1.3.3. **PCI Survey:** Identifies and documents pavement distresses caused by aircraft loadings, vehicle traffic, and environmental conditions. Base and command personnel use this data to:

1.3.3.1. Determine the operational condition of pavements;

1.3.3.2. Develop and prioritize sustainment, repair and restoration/modernization projects;

1.3.3.3. Determine whether an airfield structural pavement evaluation is needed;

1.3.3.4. Perform EAs;

1.3.3.5. Manage assets.

1.3.4. **Power Check Pad Anchor Test:** Uses specialized equipment and procedures to determine the capability of anchors to support aircraft engine tests.

1.3.5. **Engineering Assessments:** EAs are analyses currently provided as part of PCI surveys that combine data from the PCI survey, structural evaluation, friction evaluation and FOD index and are conducted to prioritize pavement O&M projects.

1.4. Asset Management. An Activity Management Plan (AMP) is prepared to determine the funding required to maintain essential infrastructure. AMPs include information on Real Property inventory, Levels of Service (LOS), Key Performance Indicators (KPI), and the planned investments (projects/requirements) identified to achieve the required LOS (see **Chapter 9**).

Chapter 2

ROLES AND RESPONSIBILITIES

2.1. HQ Air Force Reserve Command (AFRC) will:

2.1.1. Continue to execute authority over the pavement asset management program at Air Force Reserve Installations as required by 10 United States Code (USC) **chapter 1803**, 10 USC §8038, 31 USC § 1301, and AFI 65-601V1. However, AFRC shall, unless prohibited by these legal and regulatory authorities, adhere to the processes, procedures and management principles detailed in this AFI.

2.1.2. Advocate for pavement evaluation requirements and align resources to execute the pavement evaluation program at AFRC owned installations.

2.1.3. Coordinate with AFCEC to incorporate Air Force Reserve owned installation requirements into the master schedule for pavement structural evaluations, runway friction characteristics evaluations, Pavement Condition Index (PCI) surveys, and power check pad anchor tests.

2.1.4. Support AFRC owned installations in development of Pavement Management Plans (PMP) that includes a prioritized list of maintenance projects executed by contract and in-house with location, quantity, estimated cost, and the risk associated with not performing the work. (T-3).

2.1.5. Consult on pavement evaluations and perform special pavement and soil studies as needed at AFRC owned installations.

2.2. National Guard Bureau (NGB) Civil Engineer Technical Services Center (CETSC) will:

2.2.1. Continue to execute authority over the pavement asset management program at Air Force National Guard (ANG) Installations as required by 10 United States Code (USC) **chapter 1803**, 10 USC §8038, 31 USC § 1301, and AFI 65-601V1. However, ANG shall, unless prohibited by these legal and regulatory authorities, adhere to the processes, procedures and management principles detailed in this AFI.

2.2.2. Advocate for pavement evaluation requirements and align resources to execute the pavement evaluation program at ANG owned installations.

2.2.3. Coordinate with AFCEC to incorporate ANG requirements into the master schedule for pavement structural evaluations, runway friction characteristics evaluations, and power check pad anchor tests.

2.2.3.1. CETSC manage/monitors the airfield and road PCI survey program at ANG owned installations.

2.2.4. Support ANG owned installations in development of Pavement Management Plans (PMP) that includes a prioritized list of maintenance projects executed by contract and in-house with location, quantity, estimated cost, and the risk associated with not performing the work. (T-3).

2.2.5. Consult on pavement evaluations and perform special pavement and soil studies as needed at ANG owned installations.

2.3. Air Force Installation and Mission Support Center (AFIMSC) will:

2.3.1. Advocate for pavement evaluation requirements and align resources to execute the pavement evaluation program at supported installations. **(T-2).**

2.3.2. Support integration of pavement evaluation data into Air Force investment strategies. **(T-1).**

2.3.3. Determine if Geographically Separated Units should be exempted from the airfield and road PCI survey program requirements. **(T-2).**

2.4. AFCEC will:

2.4.1. Manage the Air Force airfield pavement structural evaluation, runway friction characteristics evaluation, PCI survey, and power check pad anchor testing programs. **(T-2).**

2.4.1.1. Develop/maintain the Air Force installation master schedule for pavement structural evaluations, runway friction characteristics evaluations, PCI surveys, and power check pad anchor tests. **(T-1).**

2.4.1.2. Publish an annual schedule and perform evaluations based on resource availability, contingency requirements, and other factors. **(T-2).**

2.4.2. Manage/monitor the airfield and road PCI survey program. **(T-1).**

2.4.2.1. Conduct airfield PCI surveys at least every 5-years for main operating bases and auxiliary fields (secondary). **(T-0).**

2.4.2.2. Conduct road and parking comprehensive condition assessments at least every 5-years for main operating bases and auxiliary fields. **(T-0).**

2.4.3. Maintain a central file on base and airfield PCI surveys, airfield structural pavement evaluations, runway friction characteristics evaluations, and power check pad anchor tests. **(T-1).**

2.4.4. Consult on pavement evaluations and perform special pavement and soil studies as needed.

2.4.5. Develop criteria and guidance for pavements EAs and asset management. **(T-2).**

2.4.6. Obtain/maintain Air Force certificate of networthiness for PAVER to reside on the network. **(T-1).**

2.4.7. Provide fund cite for shipping soil and core samples (reference paragraph 2.3.2.5). **(T-2).**

2.5. Base Civil Engineer (BCE) will:

2.5.1. Accumulate and maintain background information for PCI surveys, pavement evaluations, friction characteristics evaluations and update the work history and the condition in the PAVER Sustainment Management System database as work is performed on pavements. **(T-2).** Contracted functions will provide the same level of service, utilize the same Air Force mandated information technology (IT) systems, and implement the same asset and activity management principles and processes as government operated Operations Flights. **(T-1).**

2.5.2. Provide the support required for pavement evaluations. Detailed support requirements are outlined in the AFCEC base support requirements letter. As part of the responsibilities, the BCE will:

2.5.2.1. Provide local transportation, clearances for base and airfield access, runway closure times, billeting, vehicle maintenance, airfield equipment, and other required support for the evaluation teams. **(T-3).**

2.5.2.2. Provide the labor, material, and equipment to excavate and backfill test sites, if required, and repair core holes. **(T-3).**

2.5.2.3. Arrange approval for the teams to photograph pavement areas. **(T-3).**

2.5.2.4. Provide a representative to support AFCEC evaluations and surveys. **(T-3).**

2.5.2.5. Provide or arrange for shipping of pavement and soil samples when necessary in support of AFCEC Airfield Pavement Evaluation (APE) team (reference paragraph 2.1.7). **(T-3).**

2.5.2.6. Provide the construction history since the last evaluation, as-built and design drawings, and planned construction projects. **(T-3).**

2.5.2.7. Disconnect and move aircraft arresting cables to the side as requested by the Airfield Pavement Evaluation team. **(T-3).**

2.5.2.8. Provide equipment and other requirements, such as water for friction testing and crane or forklift for power check pad anchor testing. **(T-3).**

2.5.3. Provide technical assistance for runway rubber removal determinations; manage the rubber removal contract or conduct rubber removal with in-house resources. **(T-2).** Remove excessive rubber buildup prior to runway friction evaluation. **(T-3).**

2.5.4. Manage the base transportation and airfield asset management program. **(T-2).** Maintain a Pavement Management Plan (PMP) that includes a prioritized list of maintenance projects executed by contract and in-house with location, quantity, estimated cost, and the risk associated with not performing the work. **(T-3).**

2.5.5. In conjunction with the airfield manager, perform visual airfield inspections at least annually to identify M&R requirements including runway rubber removal. **(T-2).** Coordinate with contracting officer to establish appropriate M&R contracts.

2.5.6. In order to ensure that base pavement engineers have adequate knowledge on Air Force pavements, design and repair techniques, allow base pavements experts to receive and maintain adequate professional continuing education. For Air Force controlled installations with an active airfield, a pavements representative must complete the Civil Engineer School's WENG 555 *Airfield Pavement Construction Inspection* course. **(T-3).** WENG 550 *Airfield Pavement Rehabilitative Design and Maintenance* course is highly recommended for base pavement engineers.

2.5.7. Formally request out-of-cycle airfield pavement structural evaluations, runway friction characteristics evaluations, and/or anchor tests from AFCEC when needed, justified, properly supported, and prioritized. **(T-2).**

2.5.7.1. BCEs at ANG owned installations coordinate requests for out-of-cycle airfield pavement structural evaluations, runway friction characteristics evaluations, and/or anchor tests through CETSC.

2.5.7.2. BCEs at AFRC owned installations coordinate requests for out-of-cycle airfield pavement structural evaluations, runway friction characteristics evaluations, and/or anchor tests through AFRC/A4CO.

2.6. Airfield Manager will:

2.6.1. Coordinate with the Air Traffic Controlling agency to provide the annual number of operations from the Air Traffic Controlling agency. **(T-3).**

2.6.2. Coordinate with BCE on required runway rubber removal frequency. **(T-2).**

2.6.3. In conjunction with the BCE, perform visual airfield inspections at least annually, to identify M&R requirements, excess rubber buildup, etc. **(T-2).**

Chapter 3

LINEAR SEGMENTATION OF PAVEMENTS

3.1. Department of Defense (DOD) Linear Segmentation Guidance. Recent efforts by the DOD to better manage infrastructure assets resulted in the publication of new guidance on Real Property Inventory Requirements and linear segmentation of the assets. This guidance can be found at **http://www.acq.osd.mil/eie/Downloads/BSI/rpir_1-19-05.pdf** or the parent website for Business Systems and Information, **http://www.acq.osd.mil/eie/BSI/BEI_RPA.html**. It establishes a framework for a transformed real property accountability business process, and establishes data standards required to manage real property assets throughout their life cycle. This AFI provides guidelines for linear segmentation of both airfield and roadway pavements to supplement DOD guidance and provides a common framework that enables pavement evaluation data to be shared with real property, asset management, and geospatial information systems. This integration allows these systems to use the data generated by recurring pavement evaluations as an authoritative source of pavements inventory and condition data for the systems of record. The Sustainment Management System (SMS) Playbook available at **https://cs1.eis.af.mil/sites/ceportal/CEPlaybooks/SMS/Pages/default.aspx** also provides a supplement to this AFI.

3.1.1. To achieve OSD linear segmentation objectives, data elements used in pavements management are related to data elements outlined in the *OSD Real Property Information Data Model Version* and implemented in the Real Property Asset Database (RPAD). Information on these resources is available at **http://www.acq.osd.mil/eie/BSI/BEI_RPA.html**. The key field of importance is the Real Property Unique ID (RPUID) which is linked to each section, although other fields are linked as well, including the Real Property Network, Real Property Site Unique Identifier (RPSUID), Facility Number, Facility Analysis Category (FAC), and Category Code (CATCODE). Following is a description of these data elements.

3.1.1.1. **Real Property Network.** The Real Property Network groups assets based on the common service or commodity provided, such as an airfield pavement system or road, street, and parking area system. This concept aligns well with the network concept used in the pavement community. The primary criteria for a network is that is can have only one Real Property Site Unique Identifier (RPSUID). In addition, a network may be established for other reasons. For example, even though they have the same RPSUID as the main base, the roads and parking in base housing may be a separate network, especially if they have been privatized. Real property records, privatization agreements, or survey data are important in determining where exact break points are when transitioning from one network to another. Following are some examples of networks that are established:

- Airfield network for main base.
- Paved and unpaved road and parking network for main base.
- Airfield network for auxiliary fields or landing zones.
- Paved and unpaved road and parking network for auxiliary fields or GSUs.
- Paved road, driveway and parking network for housing.

3.1.1.2. **RPSUID.** The RPSUID is a unique number that is assigned to each site by OSD. In most cases this equates to an installation.

3.1.1.3. **RPUID.** The RPUID is a non-intelligent code assigned by OSD used to permanently and uniquely identify a real property asset. Note that there is a one-to-one relationship between the RPUID and the facility number.

3.1.1.4. **Facility Number.** The facility number has historically been used to identify real property assets on AF installations. AFI 32-9005, *Real Property Accountability and Reporting*, paragraph 3.5. lists the facility number as one of the required fields that must be used when conducting a physical inventory.

3.1.1.5. **FAC.** The FAC is an OSD level designator that represents the current use by the assigned user of a specific portion of the real property asset. For example FAC 1111 identifies a runway.

3.1.1.6. **CATCODE.** The CATCODE is a Military Service designator that represents the current use by the assigned user of a specific portion of a real property asset. Each FAC has one or more CATCODES assigned to it. For example CATCODE 111111 is the Air Force CATCODE for runways. Note that CATCODES are not the same among the services. A pavements facility can have only one CATCODE.

3.2. Pavement Management Segmentation. For many years, engineers have segmented pavement systems into basic units, designating pavements with common characteristics as networks, branches, and sections. **Figure 3.2.** shows the accepted schema for naming segments on an airfield and **Figure 3.3.** shows the schema for roads and parking areas. Unified Facilities Criteria (UFC) 3-260-01, *Airfield and Heliport Planning and Design*; UFC 3-260-02, *Pavement Design for Airfields*; and UFC 3-260-03, *Airfield Pavement Evaluation;* also provide information on segmentation and procedures for identifying branches and sections of airfield pavements for both PCI and structural pavement evaluations.

3.2.1. **Network.** A network is typically characterized as all pavements with a similar function, such as all airfield pavements or all roads and parking areas on a base. This construct aligns well with the Real Property definition of a network as described above. Networks are further subdivided into branches that are a logical subset of the network.

3.2.2. **Branch.** A branch is a subset of the network such as a runway, a named taxiway or an apron for an airfield, or a named road or parking area. Branches are subdivided into sections that are a subset of the branch with specific physical or usage characteristics.

3.2.3. **Section.** A section is a subset of a branch and is assigned based on characteristics such as pavement type, use, structure, construction history, traffic area, rank, or condition. Some of these characteristics, such as traffic area, are just applicable to airfields, while others, such as pavement type apply to both airfields and roads.

3.2.3.1. **Pavement Type.** There are several pavement types: flexible, rigid, rigid or flexible overlay on rigid, flexible overlay on flexible, composite, and reinforced rigid, as well as unsurfaced. A specific section contains only one pavement type.

3.2.3.2. **Pavement Use.** Airfield pavements consist of runways, taxiways, aprons, overruns, other airfield pavements (e.g. aircraft ground equipment (AGE) storage), and shoulders. The pavements not associated with the airfield on a base consist of roads, parking areas, and driveways. A section typically has a single pavement use.

3.2.3.3. **Pavement Structure.** The thickness and strength of the pavement and soil layers usually vary considerably throughout an airfield or road and parking system; however, each discrete pavement section will have relatively uniform cross-sectional properties to represent the section.

3.2.3.4. **Construction History.** In most cases, pavements are constructed using different materials and techniques on various portions of the airfield or base at different times. All pavements included in a specific section have a consistent construction history.

3.2.3.5. **Pavement Rank.** Pavement sections are assigned a rank; Primary, Secondary, Tertiary, or Unused to help define the priority of the structure in the asset management system as described in paragraph 9.3.1. A branch can contain pavements with more than one rank, so each section within the branch is assigned a rank.

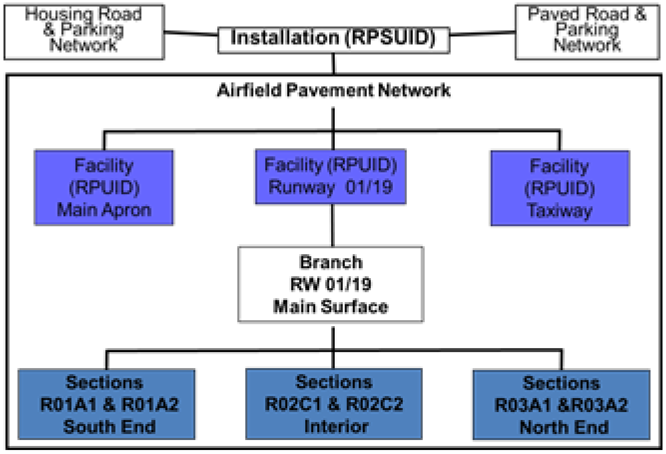
3.2.3.6. **Traffic Areas.** Airfield pavements are divided into traffic areas based on the lateral distribution of aircraft traffic and effective gross aircraft load. These areas are designated types A, B, C, and D. A section typically has a single traffic area designation (e.g. A01B has a B traffic area). Further details regarding traffic area segmentation rules are provided in paragraph 3.6.

3.2.3.7. **Pavement Condition.** Each pavement section has consistent characteristics as addressed in paragraphs 3.2.3.1 through 3.2.3.6. Sometimes the condition of the pavement in an area varies considerably. In this situation, the discrete pavement area can be subdivided into separate pavement sections based on the surface condition of the pavement. See paragraph 3.6.4 for details on creating sections based on condition.

3.3. Correlation of Real Property and Engineering Pavement Linear Segmentation Data. The general hierarchy for integrating pavement's real property and engineering data is network, facility, branch, and section. Typically, there will be a one-to-many relationship between each of these entities within the hierarchy (See **Figure 3.1.** below).

3.3.1. **Pavement Facilities and Category Codes:** In pavement terms, a facility is an area of pavement with a specific function such as a runway, apron, taxiway, overrun, shoulder, roadway(s), or parking area(s). In real property guidance, the primary constraint for creating a linear facility is that category codes cannot be mixed. For example, overruns (category code 111115) cannot be combined in a facility with the main load bearing surface of the runway (category code 111111).

Figure 3.1. Segmentation Hierarchy.



3.3.2. **Creation/Designation of Pavement Facilities.** Real Property guidance requires a real property record be prepared for each real property asset. In practice, bases have implemented these rules in many different ways. Each base will have a pavement facility map that shows the geospatial extents of each pavement facility in its real property records. **(T-2).** If the base does not have one, it must create it to comply with Executive Order 13327 "Federal Real Property Asset management. **(T-1).** The SMS Playbook, **https://cs1.eis.af.mil/sites/ceportal/CEPlaybooks/SMS/Pages/default.aspx** provides additional information on creating pavement facility maps. The intent of the playbook is to provide standard guidance for creating pavement facilities to reduce the variability from base to base outlined below whenever updates/changes are needed. Following are standards for defining pavement facilities:

3.3.2.1. **Runways.** The load bearing pavement for each runway at a base will have its own facility number. The overruns for the runway will have a separate facility number, and the runway shoulders will have a separate facility as well. Use the predominant material type for each runway and overrun to populate the construction material code in ACES / TRIRIGA.

3.3.2.2. **Taxiways.** The base may include all taxiways in one facility or may opt to create a facility for each named taxiway, but in no case will a base create multiple facilities for a named taxiway. Bases will not create facilities based on pavement type. This level of fidelity will be provided in the segments. For instance, Taxiway A will have only one facility number assigned even though itis constructed of both concrete and asphalt pavement. Use the predominant material type for each taxiway facility to populate the construction material code in ACES / TRIRIGA. If all taxiways are aggregated in one facility, combine all taxiway shoulders into one facility. If each named taxiway has its own facility number, the shoulders associated with each taxiway will be in a separate facility.

3.3.2.3. **Aprons.** Each contiguous main parking apron will have its own facility number. Dispersed parking pads with similar construction dates will be aggregated in one facility. Bases shall not create separate facilities based on pavement type (construction material code). Use the predominant material type for each apron facility to populate the construction material code in ACES / TRIRIGA®.

3.3.2.4. **Roads, Streets and Access Roads.** The term road is typically intended to mean highways, roads, and streets. OSD guidance calls for all surfaced roads (CATCODE 851147) on a base to be included in one facility. A separate facility will also be created for all unsurfaced roads (CATCODE 852101). In no case will a base create a separate facility for all concrete roads and one for all asphalt roads. Use the predominant material type for each road facility to populate the construction material code in ACES / TRIRIGA. In addition, any pavement that provides access to a building, loading dock, dumpster, etc., is considered a road rather than a driveway.

3.3.2.5. **Driveways.** The term driveway has been used to refer to pavements that provide access to buildings, loading docks, dumpsters, parking areas, etc. The current AF real property definition of a driveway (CATCODE 851145) is a private road leading from a street or other thoroughfare to a building, house, or garage. It is normally a hard surfaced road constructed of concrete or asphalt. UFC 3-250-01FA, *Design of Roads Streets, Walks and Parking Areas* and UFC 3-250-18FA, *Geometric Design for Roads Streets and Walks* clearly intends for the term driveway to be associated with a residence in the housing area. Driveway facilities will be used to designate driveways in base housing areas only. All surfaced driveways associate with a given housing area will be included in one facility. In no case will a separate facility be created for all concrete driveways and one for any asphalt driveways, or some variation thereof. Use the predominant material type for each driveway facility to populate the construction material code in ACES / TRIRIGA.

3.3.2.6. **Parking Areas.** Parking areas include both the parking area itself and the pavement that provides access to the parking area. There are currently six different category codes for surfaced and unsurfaced parking areas. At a minimum, a separate facility should be created for the pavements in each of these category codes. The main rule of thumb is that parking areas with different category codes cannot be included in the same facility. Do not create separate facilities for concrete parking areas and asphalt parking areas. Use the predominant material type for each parking area facility to populate the construction material code in ACES / TRIRIGA.

3.4. Assigning Branches and Sections Facilities. The pavement facility map plays a crucial role in correlating engineering pavement segments (branches and sections) to pavement facilities. To start the correlation process, obtain the pavement facility map depicting the location of each pavement facility on the base from the responsible GeoBase office. As mentioned previously, if the base does not have this map, the base must ensure it is created. **(T-2).** Without this map, it is not possible, to correlate engineering segments to real property pavement facilities. The map should clearly show the geospatial extent of each pavement facility listed in the real property record. It includes all paved and unpaved airfield, road, driveway, and parking surfaces.

3.4.1. In order to align branches and sections from the pavement management system with facilities in the real property system, branches and sections used in past pavement evaluations may need to be modified to align with the facility/branch hierarchy and to ensure the boundaries of the branches and sections align properly with the facilities.

3.4.2. When problems or discrepancies are identified, such as inability to maintain facility branch hierarchy, incorrect facility boundaries, or erroneous category codes, discuss the issue with the base pavement engineer, real property officer and the GeoBase office and make needed changes to real property facility numbers and the pavement facility map outlined in the Pavement Linear Segmentation Playbook.

3.4.3. The real property data elements identified in section 3.1 are integral to the PAVER 7.0 data schema so pavements management data and real property facility data can be correlated. The real property data elements are assigned at the network, branch or section level as appropriate. PAVER and the Pavement Computer Aided Structural Engineering (PCASE) program share inventory, meaning that PCASE uses the same branch and section structure as PAVER and data for a given base can be stored in a common database for use by both programs.

3.4.4. PAVER and PCASE have a GIS capability which allows the user to import a shape file and create associations between the branches and sections in the inventory and the polygons on the map that define the geospatial extent of the branches and sections. Creating these relationships using PAVER-PCASE ensures adherence to all business rules.

3.4.5. Once a relationship is created between facilities, branches, and sections, the area and condition data in PAVER, as well as the structural capacity data generated by PCASE, can be shared with real property, asset management, and geospatial information systems. The primary key used to exchange data between PAVER-PCASE and these other systems is the RPUID.

3.5. Branch Level Airfield Pavement Segmentation Rules. A branch is assigned to only one facility and a section is assigned to only one branch. A branch is given both a branch name and a branch unique ID in PAVER-PCASE. If a branch has multiple facility numbers assigned, the Real Property Officer (RPO), base pavement engineer, and GeoBase office should work together to resolve the issue. Following are some general guidelines for assigning branches to facilities:

3.5.1. **Runways.** The load bearing surface of each runway is typically a branch. Assign that branch to the facility for that runway. The overruns for a runway constitute one branch. Assign the overrun branch to the overrun facility for that runway. The shoulders for each runway are typically a branch. Assign that branch to the appropriate shoulder facility whether all shoulders are one facility or there is a separate facility for runway shoulders.

3.5.2. **Taxiways.** For linear segmentation and evaluation purposes, a taxiway is defined as one with an alphanumeric designation (e.g. Taxiway A, Taxiway A1). The distinction is discussed further in paragraph 3.6.7. In pavement management, the load bearing surface of each named taxiway is typically a branch. If the taxiway has a shredout (e.g. Taxiway A1) include it in the branch with the same alpha designation; in this this example, Taxiway A. Assign these branches to the appropriate facility number per the pavement facility map. The shoulders for taxiways are also given a branch designation. Assign that branch to the appropriate shoulder facility, whether all shoulders are one facility or there is a separate facility for taxiway shoulders.

3.5.3. **Aprons.** Aprons are more of a challenge than runways and taxiways. There are ten different category codes for various types of aprons. In general, aprons can be divided into two types; those used to park aircraft, such as a main parking apron or dispersed parking pads, and those used for short-term parking, such as an arm/disarm pad, a hangar access apron, or an AGE equipment parking area. There is one category code for aircraft parking aprons and nine for other aprons used by aircraft and support equipment. Main parking aprons or dispersed parking pads (CATCODE 113321) have an AP prefix in the branch name (e.g. APMAIN) and all other aprons/pads have an OA prefix in the branch name (e.g. OAHOTCARGO).

3.5.3.1. Divide each contiguous main apron into separate branches based on operational use. For example, a portion of the apron is used for the primary mission aircraft and a portion is used for transient aircraft or an Air National Guard or Reserve mission. These branches are assigned to the appropriate facility as needed.

3.5.3.2. Dispersed parking aprons are typically grouped into a single branch. For instance, all parking pads on the loop taxiway would be in the branch APLOOP. If each of the individual pads has been assigned a facility number, creating a separate branch for each of these facilities significantly complicates analysis. In these instances, work with the RPO, base pavement engineer, and GeoBase office to resolve the issue by aggregating the dispersed parking pads in a single facility as described previously.

3.5.3.3. For other aprons, use the category code as the guide for creating branches. For example, all arm/disarm pads (CATCODE 116661) on an airfield are included in a branch. If the base has created a separate facility for each arm / disarm pad, create a separate branch for each. Create a separate branch for compass calibration pads, power check pads, dangerous cargo pads, etc.

3.5.3.4. The shoulders for all aprons are assigned to a branch. Shoulder branches are assigned to the appropriate facility. Assign that branch to the appropriate shoulder facility whether all shoulders are one facility or there is a separate facility for apron shoulders.

3.5.3.5. Apron pavements used exclusively as AGE equipment parking areas (CATCODE 852273) or Vehicle Parking Refueling (CATCODE 852269) are not given a traffic type in the inventory. Note: this does not apply to areas where AGE equipment or aircraft refueling trucks may be occasionally parked on other apron pavements.

3.6. Section Lvel Airfield Pavement Segmentation Rules. In addition to the branch level rules outlined above, other general rules apply to creating and modifying sections. The SMS Playbook; **https://cs1.eis.af.mil/sites/ceportal/CEPlaybooks/SMS/Pages/default.aspx** gives some specific examples to supplement the information provided below.

3.6.1. Airfield Section Naming Conventions. **Figure 3.2.** below provides an overview of the rules and codes for designating sections. Each airfield section for a specific network has a unique number assigned. For instance, section R01A1 could identify the keel section of the first thousand feet on a given runway. That section number is not used anywhere else on that airfield.

3.6.2. As new sections are created and old ones deleted, over time the section numbering on a base can become complicated. In the past, teams would completely re-number the sectioning on a base to follow a pattern and make it easier to locate sections. While renumbering the whole airfield or road network does make locating sections easier, it presents other issues with continuity. Therefore, do not completely re-number pavement sections to “clean up” the drawing as part of an evaluation. The benefit of each section having the same number over time outweighs the inconvenience. This is especially true when trying to correlate pavement management data with real property and asset management systems.

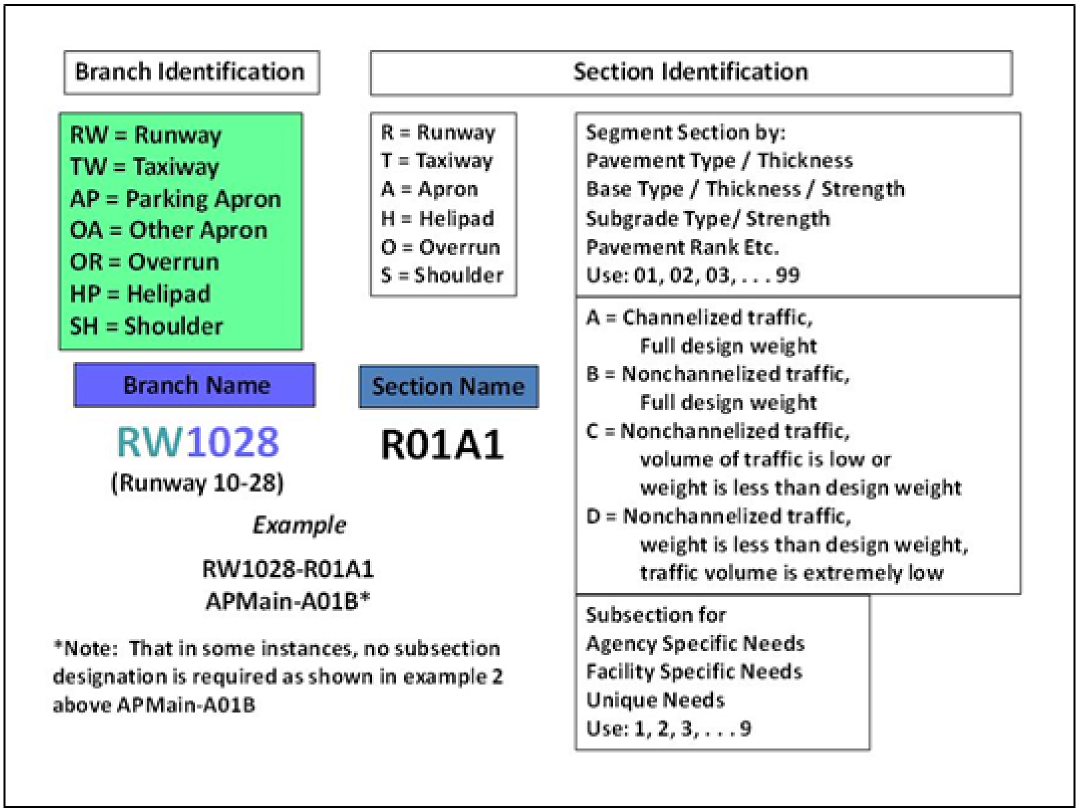
3.6.3. If a new section is created, give it the next consecutive number available or shred out the section if only a portion of a section is reconstructed and it is structurally the same as the parent section (for example, A10B would be shred out into A10B1 and A10B2). If a section is reconstructed, but the geospatial extents do not change significantly, keep the same section number. If the section is reconstructed and the shape changes significantly, DO NOT re-use section number. Delete the section number in the physical property data (PPD) sheet, but retain it in the construction history with a note that it was demolished or reconstructed. Due to inconsistent application of these rules in the past, there may be gaps in section numbering, but no clear indication of why these numbers are no longer used. If the omitted section numbers are verified as not being used in past evaluation reports, the numbers may be used. Once a number is assigned, do not use it again.

3.6.4. Each pavement section has relatively uniform cross-sectional properties. Sections can be created with shredouts if they are structurally the same but have a different rank or significantly different PCI. The primary purpose for this business rule is to allow pavement evaluation teams and other users to quickly identify pavements with similar structures on a map and to increase the efficiency of testing. Sections with shredouts are consolidated when performing coring, dynamic cone penetrometer, and heavyweight deflectometer (HWD) testing.

3.6.4.1. Do not shred out a section that has different physical characteristics. If a portion of a section is reconstructed and is now structurally different, the new portion should get a new section number. For example, a portion of an asphalt ladder taxiway section, T14C, is reconstructed with concrete as part of a runway military construction (MILCON) project. The new section should be given the next consecutive unassigned section number rather than dividing the section into T14C1 and T14C2.

3.6.4.2. A pavement that is milled and overlaid with the same thickness of asphalt that was in the original section would be considered structurally similar unless heavyweight deflectometer testing indicates otherwise.

Figure 3.2. Airfield Segmentation Schema.



3.6.5. **Runways.** The keel section of the runway sees a much higher volume of traffic than the outer portions and therefore usually has a different PCI deterioration rate. To address this issue, designate the keel section of the runway as a section separate from the outer portions. The keel section is given a shred out (e.g. R01A1) and the outer (noncontiguous) portions of the runway are given a shred out (e.g. R01A2). The R01A designation indicates that both sections have similar construction and the shredout indicates the sections have another characteristic that warrants they be separated, such as rank or in this case, PCI.

3.6.6. **Overruns.** Overruns and the outside portion of some runways are designed using a D traffic area. For evaluation purposes, overruns are typically evaluated with a C traffic area if evaluated for load bearing capacity with the exception of section 3.6.6.1 below. The primary reason for this is that evaluating an overrun with a D traffic area results in high allowable gross loads (AGLs) and a pavement classification number (PCN) that may be misleading to those using the report. Typically, an overrun has a tertiary rank unless there is an aircraft arresting system present in which case it will be secondary.

3.6.6.1. Overruns can be constructed with a Type A traffic area to increase the takeoff length for mission aircraft. In these instances, the pavement should be marked with a displaced threshold and classified (CATCODE) as a runway rather than an overrun. The section has an R designation, be given an A traffic area, and it is identified as a primary pavement. Overruns on unsurfaced landing zones are always evaluated as A traffic.

3.6.6.2. If it is marked as a runway with a displaced threshold but is included in an overrun facility, identify the issue to the base to update the current use (CATCODE). If the CATCODE is correct, label it as an overrun with an A traffic area and give it a primary rank.

3.6.7. **Taxiways, Access Taxiways, and Taxilanes.** While the term taxiway is often used for all three of these entities, they are each defined slightly differently and are treated differently. See UFC 3-260-01, *Airfield and Heliport Planning and Design*, and UFC 3-260-02, *Pavement Design for Airfields* for specific definitions.

3.6.7.1. For linear segmentation and evaluation purposes a taxiway is defined as having an alphanumeric designation (e.g. Taxiway A, Taxiway A1 or East Loop Taxiway). If a named taxiway passes through an apron, it is considered a separate branch/section than the apron pavement. As shown in **Figure 3.2.**, a taxiway has a T designation. A primary taxiway has an A traffic area, while ladder taxiways or taxiways that only have a low volume of traffic typically have a C traffic area.

3.6.7.2. A taxilane on an apron does not typically have an alpha designation. It may or may not have the same representative thickness as the apron but is considered part of the apron in either case. If the taxilane has a different structure than the surrounding apron pavement, it is subdivided into a separate section of the apron branch, given an A prefix and given the same traffic area as the surrounding apron; typically B type traffic for a main apron or C for a hangar access apron.

3.6.7.3. Access taxiways may or may not have an alphanumeric designation and as the name implies, have the sole purpose of providing access to a main or hangar access apron, pad, or washrack, etc. Historically, access taxiways have been given either A or T designations and may have A, B, or C traffic areas. In an effort to standardize, many past designations need to be updated. Following is guidance for these updates: Do not create a separate section for an access taxiway if it is the same construction as the apron or pad that it is accessing. If the construction is different, make it a separate section and give it a T designation. Note that even though it has a T designation, it is considered part of the apron facility and branch and has the appropriate apron CATCODE. It has the same traffic area as the apron or pad to which it provides access. This is typically either B or C traffic as outlined in UFC 3-260-02, Figures 3-1 thru 3-3.

3.6.8. **Shoulders.** Shoulders are typically designed to support vehicle traffic and are not given a traffic area in design. AFCEC does not evaluate the structural capability of shoulders as part of an evaluation. Shoulder pavement is not given a traffic type in the inventory.

3.6.9. **Random Slab Replacement and Minor Asphalt Repairs.** Do not subdivide sections that have randomly replaced slabs, have asphalt patches or small areas where the asphalt has been replaced. Generally, a section should only be subdivided when it is a large section and the replaced pavement is contiguous and comprises 25 percent or more of the existing section. Determining what constitutes a large section and when to break out a section involves engineering judgment. The intent is not to break out sections unless it has a significant impact to the outcome of the evaluation or the ability of the base to manage their pavement.

3.6.10. **Pavement Rank.** Sections may be created to differentiate between the relative importance of the pavement to the mission. Consider a situation where the main apron was built at one time with similar construction throughout and is assigned a facility number. Assume the facility has one branch (APMAIN). Currently a portion of the apron supports the assigned flying mission, but half the apron is only used occasionally for air shows or overflow transient aircraft. The portion of the apron that supports the active mission is primary and the remaining apron is tertiary. Divide the apron into two sections (A01B1 primary and A01B2 tertiary for example). That they both have the designation A01B indicates they are structurally similar and the shredout is used to differentiate other differences, such as rank in this case.

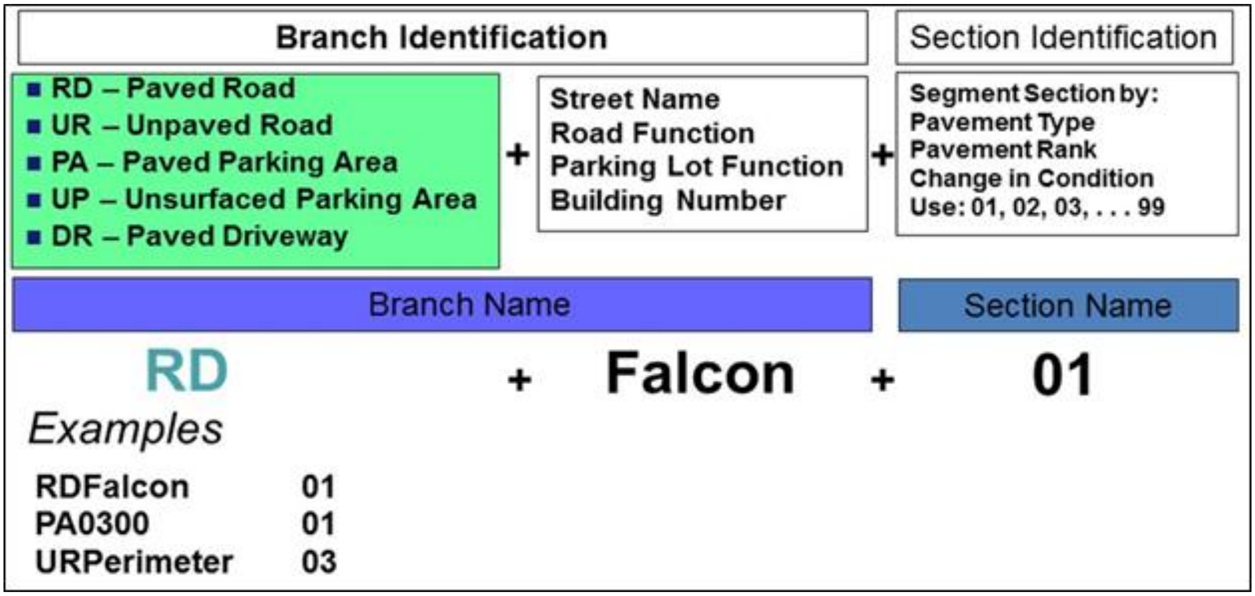
3.6.11. **Pavement Condition.** In general, only shred out additional sections on an apron or taxiway due to condition if the area involved is 25% or more of the total section area and the weighted area average PCI of the sample units within each area differs by at least 15 points. Note that these criteria are somewhat arbitrary and are intended as a rule of thumb. The objective is to only create new sections that significantly impact the results of the evaluation. Don't subdivide small sections.

3.7. Segmentation of Roads, Driveways, and Vehicle Parking Areas. As outlined in paragraph 3.4., the starting point for aligning branches and sections from the pavement management system with real property facilities is obtaining a pavement facility map that clearly shows the geospatial extent of each pavement facility listed in the real property record (including paved and unpaved roads, drives, and parking areas). If the base does not have a pavement facility map, they must create it before branches and sections can be assigned to the facilities. **(T-2).** The base Real Property Officer will work with the base Pavement Engineer and the GeoBase office to ensure that each pavement facility on a base is identified on the map. **(T-3).**

3.7.1. The segmentation taxonomy for roadways and parking areas, as for airfields, is network, branch, and section, as shown in **Figure 3.3.** The same processes described above for creating a pavement facility map and assigning branches and sections to airfield facilities applies. In addition, the same hierarchy shown in **Figure 3.1.** for network, facility, branch, and section applies to roads and parking areas. Following are some specific rules for segmenting roads and vehicle parking areas.

3.7.2. Several networks are typically created for an installation. One is created for all paved and unpaved roads, driveways, and parking areas. In most instances, a separate network is created for housing areas, especially if there is indication they may be privatized. Separate networks are also created for the roads and parking associated with geographically separate sites.

Figure 3.3. Segmentation of Roads and Parking Lots.



3.7.3. **Branches.** Historically, each named road on a base and each parking area or group of parking areas associated with a specific building or function have been given a branch designation. Following are specific rules for creating these branches.

3.7.3.1. **Road Branches.** Each named road on a base is designated as a separate branch. Each of these branches is assigned a rank based on the criteria outlined in paragraph 9.3.2. If a portion of a named road is primary and another portion is secondary, create separate sections for each.

3.7.3.1.1. The process of assigning branches and sections is straight-forward, if all paved roads on a base are assigned to one facility. However, it becomes more complex when a base has multiple road facilities. Branches are created to ensure that no branch is assigned to more than one facility. If a base has two sites or networks and a branch crosses into different sites or networks, the branch is divided to ensure a branch is not assigned to more than one network.

3.7.3.2. **Assigning Road Branches.** A surfaced road uses the prefix RD and unsurfaced road uses the prefix UR. The road name is used as the remainder of the branch name (e.g. RDMAIN or URPERIMETER). There are instances where the road does not have a name, especially unsurfaced roads. In these cases, give unnamed roads temporary names (URUNAMED1, 2, 3, etc.). Before completing the report have the base review all unnamed roads and provide names if they are available. If names are not available, use the temporary name assigned.

3.7.3.3. **Parking Area Branches.** Assign each parking area or group of parking areas associated with a specific building or function a branch ID and name. Note that a parking area branch includes the access road or access driveway servicing that parking area. Each of these branches is assigned to the appropriate facility. This is straight forward when all parking areas on a base are combined into one facility for each respective category code or each parking area has its own facility number. The pavement facility map for roads and parking provides the primary guide for assigning branches to facilities.

3.7.3.4. **Assigning Parking Area Branches.** Typically, the parking area uses the building number it is associated with or the function of the parking area as the branch name (e.g. PA1138 or PAEXCHANGE). If the parking area does not have a name; especially unsurfaced parking areas, give the unnamed parking area a temporary name (PAUNNAMED1, 2, 3, etc.). Before completing the report have the base review all unnamed parking areas and provide names if they are available. If they are not available, use the temporary name.

3.7.4. **Sections.** A section is a portion of a branch that differs in pavement characteristics from other sections such that segmentation is needed to uniquely identify that section. This may include pavement type, construction history, traffic volume, or other physical characteristics, such as the number of lanes in the case of a road. Note that sections for roads and parking are treated differently than those for airfields in that the section number for a road or parking area is unique for each branch but is not unique for the base as a whole. For example, the branch for Main Street, RDMAIN has 24 sections numbered 01 thru 24. The branch for Flightline Road, RDFLIGHT is made up of 16 sections numbered 01 thru 16. The only way to distinguish a section uniquely is by the concatenation (branch ID plus section ID) of the branch and the section.

3.7.4.1. **Road Sections.** If there is a long road section with consistent physical characteristics, create a section break approximately every half mile. Since base roads do not typically have mile markers, try to create these breaks where the road intersects with another road, a parking area, or some other distinguishable feature. The intent of this guidance is not to create a section break at each intersection, but rather to create enough sections to ensure adequate sampling for projecting maintenance and repair requirements.

3.7.4.2. **Section Breaks at Intersections.** Pavement section breaks are not created at each intersection unless there is a change in characteristics or some other factor that drives the creation of the section break at that intersection. When required at an intersection, the section break is shown as a single line perpendicular to the centerline. The pavement in the intersection is assigned to the road with the higher rank. When roads are of equal rank, the pavement in the intersection is assigned to one of the roads, ensuring there is no double counting of pavement area.

3.7.4.3. **Parking Area Sections.** Similar to roads and airfields, parking area branches are subdivided into sections based on their physical characteristics or construction history. The access road serving a parking area is part of the branch for that parking area and is assigned the appropriate parking area category code for that facility. If the pavement that provides access to the parking area has the same construction as the parking area it serves, it can be included with the parking area section. If the pavement is constructed differently or is long, it is assigned a separate section number.

3.7.4.4. **Driveways.** As mentioned in 3.3.2.5, the term driveway refers specifically to pavements in housing that services a residence(s). All driveways on a base may be included in a single facility or each specific housing area may be designated as a separate facility. All driveways on a given street should be included in a single branch and that branch assigned to the appropriate driveway facility. Each individual driveway may be assigned a section if it has sufficient area, or groups of driveways with similar characteristics may be combined in a section to get an adequate sample unit. Note that if the housing area is privatized, inventory the roads, driveways, and parking, but do not inspect them. If the housing area is not privatized, inspect the pavements unless otherwise stipulated in the Statement of Work.

3.8. Pavement Segmentation Mapping. Mapping plays a key role in achieving the OSD linear segmentation objectives. In order to ensure the entire pavement inventory is mapped consistently and accurately, pavement evaluation teams and contractors use the following process when doing a structural pavement evaluation or pavement condition index survey. Additional details can be found in the SMS Playbook that can be accessed at **https://cs1.eis.af.mil/sites/ceportal/CEPlaybooks/SMS/Pages/default.aspx**

3.8.1. Obtain the latest Pavement Facility Map and Common Installation Picture (CIP) as well as the latest imagery from the base prior to beginning the evaluation. Ensure the metadata associated with both the CIP and imagery and determine the source and accuracy of the vector data in the CIP. In addition obtain a copy of the Airfield Pavement Plan (E-7 Tab), and Airfield Pavement Details (E-8 Tab) if available. Identify any significant issues with the mapping, such as misaligned pavements, duplicate polygons, or other issues that affect the accuracy of the map. The metadata plays a key role in that the pavement vector data in the CIP may have been generated from earlier imagery or an actual survey. If this is the case, the vector data may not align with the current imagery. Ensure that any changes made to the CIP are based on more accurate data. Work with the installation GeoBase office to resolve any issues prior to the start of the evaluation.

3.8.2. Current guidance in this AFI drives changes to past pavement segmentation. Make any required changes to the branches and sections based on the current imagery, pavement facility map, and construction history data provided by the base prior to the evaluation. During the evaluation, make modifications to the branches and sections as well as any changes required to the CIP based on field observations. Document the changes made to the CIP for coordination with the base as a separate document when submitting the report.

3.8.3. Provide a copy of the updated map (in shape file format), along with the change documentation, to the base GeoBase office for review at the base outbrief. Address all base comments regarding mapping and provide the base with a response on resolution of comments.

3.8.4. Provide a copy of the updated map (in shape file format and/or geodatabase format) with the final report. Note that in addition to the shape file, contractors are required to provide all source files in ESRI or AutoCAD format, as appropriate. **(T-3).**

Chapter 4

COMPREHENSIVE AIRFIELD PAVEMENT EVALUATION

4.1. Basic Concepts. In theory, the pavement evaluation procedure is the reverse of the design procedure. The design procedure uses a known design aircraft loading and foundation strength to determine the physical characteristics of the required pavement structure. The evaluation procedure uses known physical characteristics to determine allowable gross loads (AGL) at various pass levels for specific aircraft groups. In addition to structural considerations, a visual survey is conducted; although there is not a direct correlation between surface condition and pavement strength, the current condition and level of distress can indicate areas of concern (weak subsurface, overloading, etc.). This section outlines some basic principles and factors that affect pavements and explains how to systematically obtain physical property data.

4.1.1. **Size of Load.**

4.1.1.1. To compute loads on the pavement structure, the Air Force uses: aircraft gross weights; gear configurations; tire spacing (for multiple wheel assemblies); tire pressure or contact area; and weight distribution/center of gravity.

4.1.1.2. To simplify the mechanics of the evaluation, AFCEC assigns Air Force and selected DOD and commercial aircraft to 14 aircraft groups (see **Figure 4.1.**). It then selects a controlling aircraft for those aircraft groups containing more than one aircraft. The controlling aircraft is the aircraft in a particular group that causes the maximum state of stress in a pavement system.

4.1.2. **Frequency of Load.** Load repetitions (aircraft passes) greatly affect pavement life. Pavement life can be expressed in terms of different aircraft weight and pass level combinations. Definitions of passes are contained in UFC 3-260-03. The Air Force evaluates each section for the 14 aircraft groups at the four pass intensity levels shown in **Figure 4.1. Figure 4.2.** shows the gear type for each aircraft and the Federal Aviation Administration (FAA) designation. Stress points used to calculate allowable loads are also indicated by the red "+" symbols under each gear configuration.

4.1.3. **Distribution of Loads.** Distribution of loads also affects pavement life. Traffic tends to be more concentrated (channelized) on taxiways and runway ends and more evenly distributed (nonchannelized) on the interior portions of runways and on aprons.

4.2. Determination of Pavement Capability.

4.2.1. **AGL.** For each section, AFCEC determines separate AGLs for the four pass intensity levels shown in **Figure 4.1.** Only four pass levels are used to simplify reporting. The AGLs associated with levels I through IV are based on the physical property data or layered elastic data for each section. For frost-susceptible areas, AFCEC publishes a second table of AGLs if applicable (see UFC 3-260-03). These AGLs are determined for each section for the four pass intensity levels but are based on reduced subgrade strength or reduced modulus values during the frost-thaw period. For sections with a PCI less than or equal to 40, the AGL is reduced by 25 percent. Values in the AGL tables are capped at 2 million pounds (907,185 kilograms).

Figure 4.1. USAF Aircraft Group Index and Pass Intensity Levels.

Aircraft Group Index

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Included Aircraft	C-12 C-21 C-23 C-38A C-41A HH-60 RC-26 RQ-4-Blk 10 T-1* T-6 T-37 UH-1H	A-10 AT-38 F-15* F-16 F-22 F-35 F-117 RQ-4-Blk 20+ T-38	CV-580* MH-53 MV-22 CV-22	C-130* C-27J C-295 CN-235	C-20* C-37	B-717* C-9 DC-9 T-43	A-320 A-321 B-727 B-737 C-22 C-40 MD-81 MD-82 MD-83 MD-87 MD-90 P-3*	A-300 A-310 B-2A B-707 B-720 B-757 C-32A* DC-8 E-3 E-8C KC-135 RC-135 VC-137	A-330 B-1 B-767 DC-10-10 L-1011 MD-10 B-767 -400ER* KC-46A	C-17* IL-76	C-5*	A-340 B-777 DC-10-30 DC-10-40 KC-10 MD-11*	A-380 AN-124 B-747 B-747-8 E-4 VC-25 B-747 -400*	B-52*

Note: * Denotes Controlling Landing Gear Configuration in Group

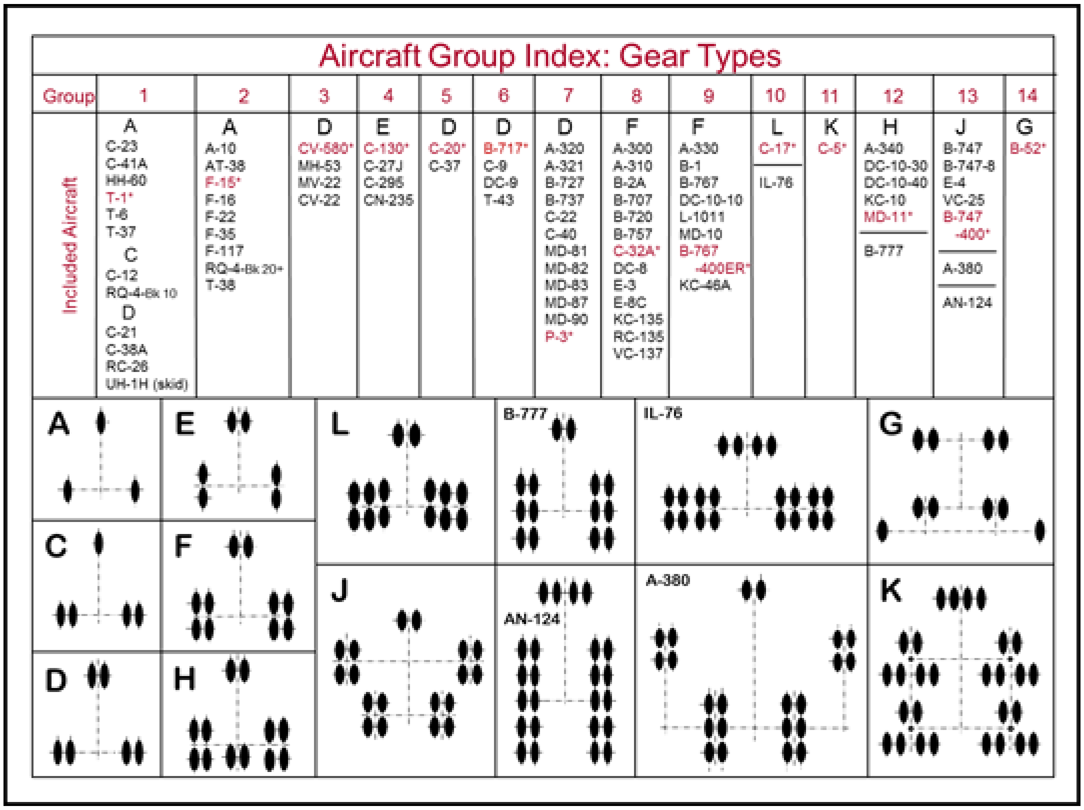
Pass Intensity Levels (in Passes)

Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	300,000		50,000											15,000
II	50,000		15,000											3,000
III	15,000		3,000											500
IV	3,000		500											100

Gross Weight Ranges for Aircraft Groups (in KIPs)

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lowest Gross Weight	4	8	23	22	39	49	55	110	177	178	374	240	342	230
Highest Gross Weight	27	84	61	175	91	121	210	376	507	585	840	775	1,301	488

Figure 4.2. Gear Types.



4.2.2. **Pavement Classification Number (PCN).** AFCEC determines and reports the airfield PCN, as defined by the International Civil Aviation Organization (ICAO), for each airfield section where aircraft actively operate. The PCN expresses the capability of a pavement to support aircraft traffic and varies with aircraft weight, gear configuration, and the number of passes. However, since ICAO only requires reporting the PCN of the runway, the runway PCN is reported on the documentation page and executive summary of the report. The runway PCN is based on the weakest section in the first 1,000 feet (305 meters) of each end of the runway (full width) or in the central keel (75 feet [23 meters]) for the remainder of the runway. Overruns and the remaining non-keel pavements of the runway interior are excluded. The Air Force standard for reporting PCNs is 50,000 passes of a C-17. This is because the C-17 is the primary heavy cargo aircraft for the Air Force and is expected to continue to be the primary heavy cargo aircraft well into the future. Using a standard aircraft and number of passes enables the Air Force to compare pavement capability across the entire Air Force. The Army and Navy select a critical aircraft and project passes or equivalent passes for the pavement life, normally 20 years.

4.2.3. **Evaluation Technique.** AFCEC follows these fundamental steps in all pavement evaluations:

4.2.3.1. Thoroughly study all existing information regarding design, construction, maintenance, and traffic history of the pavements. AFCEC also reviews:

4.2.3.1.1. Previous pavement evaluation and PCI reports.

4.2.3.1.2. Results of physical property tests of pavements.

4.2.3.1.3. Weather records for the vicinity.

4.2.3.1.4. Soils and drainage data.

4.2.3.1.5. Airfield and installation master plans.

4.2.3.1.6. Installation pavement management plans.

4.2.3.2. Determine or validate the pavement condition by a full visual (PCI) inspection. The standard PCI rating process is outlined in American Society for Testing and Materials (ASTM) D5340, *Standard Test Method for Airport Pavement Condition Index Surveys* and (ASTM) D6433, *Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys*. Note that the Air Force uses the terms standard, simplified, and cursory for it PCI surveys. The APE Team and our consultants conduct a standard evaluation in which we inspect enough random sample units to achieve a 95% confidence level. A simplified PCI uses the minimum number of random samples as outlined in the ASTM, and a cursory PCI includes an inspection of a "representative sample" that is less than the minimum number of samples outlined in the ASTM. Further details are discussed in section 8.1.4.1.

4.2.3.3. Determine the scope and validity of available data and determine what additional information and tests are needed.

4.2.3.4. Obtain field data and samples. Samples are tested in the field or sent to AFCEC for laboratory testing and data analysis.

4.2.3.5. Select the representative strength and thickness values for the individual sections that comprise the pavement structure.

4.2.3.6. Determine AGLs and PCNs for each pavement section using representative physical property data and field test results.

4.2.3.7. Develop recommendations for major M&R based on results of the evaluation.

4.3. Methods and Procedures.

4.3.1. All airfield evaluations are centrally managed at AFCEC with a comprehensive evaluation to include structural, friction, and PCI evaluations performed by AFCEC/COAP on an 8-year cycle for Active and Reserve bases with an interim PCI-only evaluations scheduled for performance by contract at the 4-year point between full structural evaluations.

4.3.2. All ANG owned installations have a full structural evaluation on a recurring 16-year schedule. CETSC conducts PCI surveys for ANG owned installations on a recurring basis. CETSC provides PCI survey reports and updated PAVER management system files to AFCEC upon completion.

4.3.3. AFCEC centrally manages road and parking PCI surveys at active duty and Air Force Reserve locations. These surveys funded through AFCEC and executed by contract on the same cycle as the airfield surveys (every four years). CETSC centrally manages road and parking PCI surveys at ANG owned installations.

4.3.4. In the fourth quarter of each fiscal year, AFCEC/COAP publishes a schedule of bases that are scheduled for an evaluation the following fiscal year. They accept input from the

MAJCOMs and bases on any needed changes and once validated by AFCEC, changes are made and the final schedule is published.

4.3.5. MAJCOMs (including AFRC) or COCOMs, or CETSC may also submit additional requests for evaluations to support exercises or contingency operations at any time. Each year's schedule takes into account the possibility of a few additional evaluations and pending quantity and priority of out-of-cycle requests, AFCEC reserves the right to alter the 16-year schedule if requirements necessitate.

4.3.6. In prioritizing requests for evaluations at additional installations, AFIMSC/MAJCOMs/AFCEC consider:

4.3.6.1. Time since the last evaluation. Structural evaluations normally occur every 7 to 10 years.

4.3.6.2. Operational requirements or mission changes that significantly change pavement loading.

4.3.6.3. Safety issues caused by structural deterioration since the last evaluation.

4.3.6.4. Plans for major reconstruction or rehabilitation projects.

4.3.6.5. New construction for which there is no sufficient design, as-built, or physical property data to determine the pavement's load-bearing capability.

4.3.7. Approximately 3 months before the evaluation, AFCEC/COAP sends a letter to the scheduled installation detailing the support required for the evaluation. For PCI contracts, AFCEC will coordinate the schedule with the bases after contract award. Once bases confirm that dates are acceptable, the contractor conducting PCI inspections sends a coordination email 30 days prior to the evaluation with information on the personnel conducting the evaluation and request for current GIS and work history information from the base.

4.4. Field Tests. During the field testing phase of an AFCEC pavement evaluation, required pavement and soil layer physical property data are obtained.

4.4.1. Base airfield operations personnel should plan on a minimum NOTAM closure of 12 hours (during daylight) for each runway that will be evaluated on the installation. However, the pavement evaluation team can respond quickly to emergencies if the runway is needed.

4.4.2. The Pavement evaluation team determines which data are needed and which specific types of tests to conduct based on pavement type, construction history, problem areas, mission, and various other factors.

4.4.3. The pavement evaluation team obtains data and samples and conducts assessments, including:

4.4.3.1. Type of pavement.

4.4.3.2. In situ pavement and soil layer thicknesses, including total thickness above the natural subgrade for flexible pavements.

4.4.3.3. Cores used to determine the thickness of surface materials and the flexural strength of the concrete using split-tensile tests.

4.4.3.4. Heavy weight deflectometer (HWD) deflection measurements used to determine pavement capability using modulus of elasticity and layered elastic theory (non-destructive evaluation).

4.4.3.5. Strength and thickness of underlying layers (California Bearing Ratio (CBR) or k (modulus of subgrade reaction) value) using the dynamic cone penetrometer (DCP) or the automated DCP (semi-destructive).

4.4.3.6. Effective modulus of subgrade reaction for rigid pavements or CBR for flexible pavements measured in excavated pits (destructive evaluation, not commonly used due to impact on operations).

4.4.3.7. Modulus of elasticity for each pavement and soil layer (non-destructive).

4.4.3.8. In situ moisture content and density of subgrade soils and base course materials (destructive evaluation).

4.4.3.9. Visual assessment of pavement surface condition (PCI) and documents by updating the PAVER database.

4.4.3.10. Soil samples, as needed. Sieve analysis and Atterberg limits tests are performed to classify the soil using the Unified Soil Classification System.

4.4.3.11. Quality of subgrade, subbase, and granular base courses (tested in situ).

Note: Laboratory tests on samples of materials and construction control data supplement the field tests. The team determines the pavement and soil layer physical properties by visual observations, laboratory tests on pavement samples, and/or from construction data.

4.5. Laboratory Tests. ASTM standards are used for laboratory and field testing. As with field testing, the data and types of tests required in the laboratory vary with the situation.

4.6. Evaluation Procedure. The evaluation team thoroughly analyzes all available physical property and laboratory data and selects representative thickness and strength data. The team also selects the appropriate evaluation methodology and computational software to utilize in order to determine the AGL and PCN for each section.

4.7. Reports.

4.7.1. **Preliminary Findings.** The pavement evaluation team typically provides an outbrief to base officials after completing field investigations. The outbrief summarizes the results of the visual inspection, field testing accomplished, preliminary test results and data analysis. Additionally, the evaluation team will provide preliminary recommendations with immediate actions required, if any.

4.7.2. **Final Pavement Evaluation Report.** AFCEC prepares, publishes, and distributes a final pavement evaluation report after all laboratory and field testing has been completed, results analyzed, and AGL and PCN values determined. The report includes:

4.7.2.1. **Background Information:** A general description of the airfield, aircraft traffic, construction history, climatic and geological conditions, soil conditions and drainage, as well as frost evaluation considerations.

4.7.2.2. **Pavement Condition:** A discussion of the findings of the visual survey, along with the other aspects of the pavement evaluation, such as structural and friction observations.

4.7.2.3. **Conclusions and Recommendations:** The engineer's conclusions and recommendations based on data analysis. Topics typically include:

4.7.2.3.1. The capability of various airfield pavement sections to support current and projected aircraft traffic;

4.7.2.3.2. Observations on the overall condition of the airfield pavements; and,

4.7.2.3.3. Recommendations for major M&R and construction.

4.7.3. **Appendices:** Information, data, and test results that document the evaluation. Table 4.1 lists the standard report appendices, which are tailored to each evaluation and may be supplemented by additional appendices when necessary.

Table 4.1. Comprehensive Airfield Pavement Report Appendices.

Appendix	Description
A	**Airfield Maps:** Graphically depicts the different pavement facilities, branches, section designations, rank, surface condition of the airfield, the overall Engineering Assessment ratings, and core test locations
B	**Real Property Information:** Includes facility information and branch-level designations
C	**PCI Deterioration Rate Table:** Historical deterioration by pavement section
D	**Summary of Physical Property Data**: Tabulates the physical properties data of each pavement section evaluated. Section area, material types, layer thickness, and engineering properties are included.
E	**Construction History:** Provides a brief summary of the construction and maintenance activities on each section
F	**Section Condition Report and Extrapolated Distresses:** Provides the PCI rating and the distresses recorded for each section
G	**FOD Potential Rating:** Provides the FOD Potential Rating (as related to the FOD Index or PCI of FOD producing distresses) used as part of the Engineering Assessment (EA)
H	**Pavement Classification Number (PCN) Table:** Lists PCNs, a standardized method of reporting pavement strength, for each section **Allowable Gross Loads (AGLs):** Lists the allowable loads for every section at four pass intensity levels for each aircraft group **Aircraft Classification Number (ACN) Charts:** Provides ACN charts for the 14 standard aircraft groups plus some additional aircraft **Related Data:** Includes aircraft group indices, gross weight limits for each aircraft group, and pass intensity levels **Structural Index Report:** Lists the structural index for the EA by section
I	**Friction Results:** Includes the texture table (surface type, rubber build-up, and outflow meter times for assessing macro-texture), average friction ratings at 40 and 60 mph for every 500 feet section of each runway, CFME readings (graphical representation) for each runway, and the friction index table as part of the EA
J	**Engineering Assessment Summary Table**: Presents EA ratings by section for each of the four categories (PCI, Structural Index, FOD Potential Rating, and Friction Index)
K	**Probability of Failure (PoF):** Uses a method outlined in the AFCEC business rules to determine a score for project prioritization along with the Consequence of Failure (CoF) **Project Development:** Provides list of projects recommended by AFCEC engineers after assessing all of the data collected during the evaluation

4.8. Distribution of Reports. Electronic copies of the structural report are provided to the base pavement engineer, airfield manager, and are kept on file at AFCEC. Additionally, copies are made available through the AFCEC Pavements Reports Web site, and notifications are sent to Air National Guard, Air Force Reserves, Defense Technical information Center (DTIC), National Geospatial-Intelligence Agency (NGA), and HQ AMC/A3. Contact AFCEC for a detailed distribution list.

4.9. Updating Physical Property Data.

4.9.1. To ensure that physical property data remain current, construction agencies must provide the as-built or design data on all airfield pavement projects to the BCE. The BCE, in turn, provides a copy of the following information to AFCEC on pavements that have been constructed or reconstructed since the last pavement evaluation:

4.9.1.1. Type of surface and texture (PCC, AC, surface treatment and burlap drag, wire combed, grooved, porous, rough, medium, and smooth, etc.).

4.9.1.2. Thickness of the pavement and each layer in the pavement structure.

4.9.1.3. Subgrade and base course moisture contents and densities.

4.9.1.4. PCC flexural strength test results.

4.9.1.5. CBR/k/modulus values from design/construction records.

4.9.2. The BCE maintains construction records, including as-built drawings on all pavement projects that are under BCE control.

4.9.3. If the airfield pavement undergoes major changes, such as reconstruction or rehabilitation, AFCEC may use as-built and construction control data to reevaluate the pavement and provide updated PCNs without conducting additional field testing (at AFCEC's discretion).

Chapter 5

RUNWAY FRICTION CHARACTERISTICS EVALUATIONS

5.1. Runway Friction Characteristics Evaluation. Runway friction characteristic evaluations assesses a runways skid resistance and it's potential to contribute to a hydroplaning incident. Since these properties are subject to change with time and traffic, an evaluation determines what, if any, maintenance may be required in order to restore pavement surface friction to acceptable levels.

5.1.1. **Frequency.** Installations should conduct runway friction characteristics testing when:

5.1.1.1. A significant portion of the runway (1000 ft. or more) has been reconstructed, altered by a surface treatment, or re-textured (grooving, or diamond grinding). AFCEC recommends including friction testing as part of the scope of the construction contract or in conjunction with a rubber removal contract.

5.1.1.2. Recent evaluation reports recommend follow-on testing or a mission change significantly alters the runway's rate of wear and rubber accumulation. AFCEC recommends a commercial vendor provide the friction testing. Contact AFCEC for recommended commercial vendors.

5.1.1.3. A mission change significantly alters the runway's rate of wear and rubber accumulation.

5.1.1.4. An aircraft skidding accident or incident occurs. Contact AFCEC to request an out-of-cycle runway friction characteristics evaluation.

5.1.2. **Evaluation Schedule.** AFCEC develops an annual friction characteristics evaluation program concurrently with comprehensive airfield pavement evaluations. The scheduling process is described in section 4.3.

5.1.3. **Support Requirements.** AFCEC provides the base detailed support requirements prior to the evaluation.

5.1.4. **Evaluation Procedures.** The evaluation report describes the procedures for evaluating runway friction characteristics, including equipment descriptions, testing methods, and some theory on their use. Testing includes friction tests, slope measurements, and texture measurements. Procedures and equipment generally correspond to those outlined in FAA Advisory Circular (AC) 150/5320-12C, *Measurement, Construction, and Maintenance of SkidResistant Airport Pavement Surfaces*.

5.1.5. **Evaluation Report.** After conducting the field evaluation, AFCEC analyzes the results and includes an interpretation of the results in the comprehensive airfield pavement evaluation report or publishes a stand-alone report. This report typically includes:

5.1.5.1. A summary of the pertinent data and results;

5.1.5.2. Interpretation of the results based on these criteria and the judgment of the engineer;

5.1.5.3. A brief narrative that presents the engineer's conclusions and recommendations for improving the runway's friction characteristics; and, 5.1.5.4. Appendices that document the data collected during testing. These appendices are described in **Table 5.1.**

Table 5.1. Friction Characteristics Evaluation Report Appendices.

Appendix	Description
A	Slope Measurements: Displays the slopes measured on the runway. The transverse and longitudinal slopes are measured every 500 feet (152 meters).
B	Texture Measurements: Presents the texture depth for various locations and the rainfall intensities required to flood these areas.
C	Friction Measurements: Contains average friction values and friction plots for the entire length of the runway and describes the guidelines for determining acceptable friction characteristics.
D	Estimation of Rubber Deposits: Presents a method to determine rubber removal requirements based on visual inspections.

5.2. Distribution of Runway Friction Characteristics Evaluation Reports. See section 4.8.

5.3. Runway Roughness Evaluation. Excessive runway profile roughness can increase fatigue on airplane components and reduce braking action. A runway roughness evaluation examines the elevation profile of the runway surface and evaluates aircraft response to this profile. Newly constructed runway pavements can be evaluated to help ensure longitudinal slopes meet established design criteria. Differential frost heave can also affect a runways longitudinal profile and cause excessive roughness. AFCEC doesn't conduct this type of evaluation but maintains contact with the National Aeronautics and Space Administration (NASA), the FAA, and other organizations conducting research in this field and with contractors that perform the evaluations. Bases requiring a runway roughness evaluation can contact AFCEC for assistance.

5.4. Runway Friction Restoration Determination. One of the leading causes of surface friction deterioration on installations is contamination of the pavement surface due to rubber build-up. Most bases schedule runway rubber removal based on the amount of time between cleanings or a visual inspection rather than measuring the friction reduction effects of the rubber accumulations using continuous friction measuring equipment (CFME). The following subparagraphs, adopted in part from FAA AC 150/5320-12C and other FAA standards, provide guidance for using a CFME unit to aid in the identification of surface friction deterioration and determine the need for rubber removal. This guidance also provides the information necessary for installations to utilize CFME information to adjust rubber removal frequencies. AFCEC does not routinely schedule friction tests strictly to determine when to remove rubber. Installations are encouraged to establish a contract avenue to have friction testing conducted in between AFCEC evaluations so that they can effectively track pavement friction performance and program surface rehabilitation and maintenance projects as needed.

5.4.1. **Background.** Skid resistance of runway pavement deteriorates due to a number of factors, primarily: 1) mechanical wear and polishing action from aircraft tires rolling or braking on the pavement and from snow removal equipment, and 2) the accumulation of contaminants, chiefly rubber, on the pavement surface. The effects of these two factors are directly dependent on the volume and type of aircraft traffic. In addition, rubber deposits obscure airfield markings, which can become a safety issue. The most persistent contaminant problem is deposits of rubber from tires of landing jet aircraft. Rubber deposits occur at the touchdown areas on runways and can be quite extensive. Heavy rubber deposits can completely cover the pavement surface texture, causing loss of aircraft braking capability and directional control, particularly when runways are wet.

5.4.2. **Minimum Friction Survey Frequency.** **Table 5.2** is provided as guidance for scheduling runway friction testing for rubber removal. This table is based on an average mix of turbojet aircraft operating on any particular runway. When, of the total aircraft mix, a runway end has 20 percent or more wide body aircraft (e.g., B-52, C-5, C-17, C-130, KC-10, KC-135, etc.), select the next higher level of aircraft operations in **Table 5.2** to determine the minimum testing frequency. As data is accumulated on the rate of change of runway friction under various traffic conditions, the scheduling of friction surveys may be adjusted to ensure that evaluators detect and predict marginal friction conditions in time to take corrective actions.

Table 5.2. Friction Testing Frequency (From FAA AC 150/5320-12C).

Number of Daily Minimum Aircraft Landings Per Runway End*	Minimum Friction Testing Frequency
Less than 15	1 year
16 to 30	6 months
31 to 90	3 months
91 to 150	1 month
151 to 210	2 weeks
Greater than 210	1 week
*Each runway end should be evaluated separately, e.g., Runway 18 and Runway 36.	

5.4.3. **General Requirements.** AFCEC does not recommend that installation seek to establish an in-house friction testing program. The cost and effort required to maintain a compliant friction testing program at the installation level is typically not an advantage to the government and has been unsuccessful in the past. Program requirements are provided below and can serve as guidelines when developing contract requirements. Installations must obtain AFCEC approval prior to purchasing of any friction testing equipment. **(T-1).**

5.4.3.1. **FAA Performance Standards for CFME.** Appendix 3 of FAA AC 150/5320-12C contains the performance specifications for CFME. These standards should be followed in procuring CFME and replacement tires for the equipment.

5.4.3.2. **FAA Qualified Product List.** The equipment listed in Appendix 4 of FAA AC 150/5320-12C has been tested and meets the FAA standards for CFME for use in conducting maintenance friction tests.

5.4.3.3. **Training of Personnel.** As stated in FAA AC 150/5320-12C, "The success of friction measurement in delivering reliable friction data depends heavily on the personnel who are responsible for operating the equipment. Adequate professional training on the operation and maintenance of the CFME and the procedures for conducting friction measurement should be provided, either as part of the procurement package or as a separate contract with the manufacturer. Also, recurrent training is necessary for review and update to ensure that the operator maintains a high level of proficiency." Experience has shown that without recurrent training, personnel are not aware of new developments on equipment calibration, maintenance, and operating techniques. A suggested training outline is provided in Appendix 5 of FAA AC 150/5320-12C. Training should include both the operation and maintenance of the CFME and the procedures for conducting friction surveys. These procedures are provided in section 5.4.4 of this AFI.

5.4.3.4. **Equipment Calibration.** All CFME should be checked for calibration within tolerances provided by the manufacturer before conducting friction surveys. The CFME self-wetting system should be calibrated periodically to ensure that the water flow rate is correct and that the amount of water produced for the required water depth is consistent and applied evenly in front of the friction measuring wheel(s) for all test speeds.

5.4.4. **Conducting Friction Evaluations with CFME.**

5.4.4.1. **Preliminary Steps.** Friction measurement operations should be preceded by a thorough visual inspection of the pavement to identify inadequacies such as drainage problems, including ponding and groove deterioration, and structural deficiencies. Careful and complete notes should be taken, not only of the CFME data but also of the visual inspection. Personnel operating equipment should be fully trained and current in all procedures. The CFME should be checked for accurate calibration and the vehicle checked for adequate braking ability. Remove aircraft arresting cables to prevent damage to equipment.

5.4.4.2. **Location of Friction Surveys on the Runway.** When conducting friction surveys on the runway(s) at 40 miles per hour (mph) (65 kilometers per hour [km/h]), the operator should begin recording data at the threshold when adequate overruns with in-ground lighting are present. If the length of the overrun is such that the operator cannot accelerate to speed before crossing the threshold, then data should be collected as soon as the vehicle reaches 40 mph (65 km/h). The friction survey should be terminated approximately 500 feet (152 meters) from the opposite end of the runway if the length of the overrun is not adequate for the operator to use the overrun for deceleration; otherwise, the survey should be terminated at the threshold. When conducting friction surveys on the runway(s) at 60 mph (97 km/h), the operator should begin recording data at the threshold when adequate overruns with in-ground lighting are present. If the length of the overrun is such that the operator cannot accelerate to speed before crossing the threshold, then data should be collected as soon as the vehicle reaches 60 mph (97 km/h). The friction survey should be terminated approximately 1,000 feet (305 meters) from the opposite end of the runway if the length of the overrun is not adequate for the operator to use the overrun for deceleration; otherwise, the survey should be terminated at the threshold. Where travel beyond the end of the runway or overrun could result in equipment damage or personal injury, additional runway length should be allowed for stopping. The lateral location on the runway for performing the tests should be 10 and 20 feet (3 and 6 meters) from the centerline. Unless surface conditions are noticeably different on either side of the runway centerline, a test on one side of the centerline in the same direction the aircraft lands should be sufficient; however, when both ends of the runway are to be evaluated, vehicle runs can be made to record data on the return trip (both ways).

5.4.4.3. **Vehicle Speed for Conducting Surveys.** FAA-approved CFME can be used at either 40 or 60 mph (65 or 97 km/h). The lower speed determines the overall macrotexture/contaminant/drainage condition of the pavement surface. The higher speed provides an indication of the condition of the surface's microtexture. A complete survey should include tests at both speeds.

5.4.4.4. **Use of CFME Self-Wetting System.** Since wet pavement always yields the lowest friction measurements, the CFME should be equipped with a self-wetting system to simulate worst case conditions. Self-wetting systems simulate rain to produce wet pavement surface conditions and provide the operator with a continuous record of friction values along the length of the runway. The attached nozzle(s) are designed to provide a uniform water depth of 0.04 inch (1 mm) in front of the friction measuring tire(s). This wetted surface produces friction values that are the most meaningful in determining whether or not corrective action is needed.

5.4.4.5. **Friction Level Classification.** Mu (μ) numbers (friction values) measured by CFME can be used as guidelines for evaluating the surface friction deterioration of runway pavements and for identifying the appropriate corrective actions necessary for safe aircraft operations. Table 3-2 of FAA AC 150/5320-12C depicts the friction values for three classification levels for FAAqualified CFME operated at 40- and 60-mph (65- and 97-km/h) test speeds. This table was developed from qualification and correlation tests conducted at NASA's Wallops Flight Facility.

5.4.4.6. **Evaluation and Maintenance Guidelines.** The evaluation and maintenance guidelines in the following subparagraphs are recommended based on the friction levels classified in Table 3-2 of FAA AC 150/5320-12C. These guidelines take into account that poor friction conditions for short distances on the runway do not pose a safety problem to aircraft, but long stretches of slippery pavement are of serious concern and require prompt remedial action.

5.4.4.6.1. **Friction Deterioration Below the Maintenance Planning Friction Level (500 feet [152 meters]).** When the average Mu value on the wet runway pavement surface at both 40 and 60 mph (65 and 97 km/h) is less than the Maintenance Planning Friction Level but above the Minimum Friction Level in Table 3-2 of FAA AC 150/5320-12C for a distance of 500 feet (152 meters), and the adjacent 500-foot (152-meter) segments are at or above the Maintenance Planning Friction Level, no corrective action is required. These readings indicate that the pavement friction is deteriorating but the situation is still within an acceptable overall condition.

5.4.4.6.2. **Friction Deterioration Below the Maintenance Planning Friction Level (1000 feet [305 meters]).** When the average Mu value on the wet runway pavement surface at both 40 and 60 mph (65 and 97 km/h) is less than the Maintenance Planning Friction Level in Table 3-2 of FAA AC 150/5320-12C for a distance of 1,000 feet (305 meters) or more, an extensive evaluation should be conducted to determine the causes and extent of the friction deterioration. If the surface has rubber buildup, the airfield manager should submit a work request to have rubber removed from the affected areas of the runway.

5.4.4.6.3. **Friction Deterioration Below the Minimum Friction Level.** When the average Mu value on the wet pavement surface at both 40 and 60 mph (65 and 97 km/h) is below the Minimum Friction Level in Table 3-2 of FAA AC 150/5320-12C for a distance of 500 feet (152 meters), and the adjacent 500-foot (152-meter) segments are below the Maintenance Planning Friction Level, action should be taken immediately to correct the affected areas of the runway. Before undertaking corrective measures, inspect the overall condition of the entire runway pavement surface to determine if other deficiencies exist that may require additional corrective action.

5.4.4.6.4. **Additional Testing Requirements.** Texture and slope (longitudinal and transverse) measurements should be taken if less than optimal Mu values result from CFME testing. Rubber build-up can also be categorized by using classifications found in **Figure 5.1.** This additional information will assist in the determination of the appropriate corrective action needed to restore surface friction characteristics.

Figure 5.1. Estimation of Rubber Deposits.

Estimation of Rubber Deposits

Classification of rubber deposit accumulation	Estimated percentage of rubber covering pavement texture in touchdown zone of runway	Description of rubber covering pavement texture in touchdown zone of runway as observed by evaluator
Very Light	Less than 5%	Intermittent tire tracks; 95% of surface texture exposed.
Light	6 – 20%	Individual tire tracks begin to overlap; 80 – 94% surface texture exposed.
Light to Medium	21 – 40%	Central 6m traffic area covered; 60 – 79% surface texture exposed.
Medium	41 – 60%	Central 12m traffic area covered; 40 – 59% surface texture exposed.
Medium to Heavy	61 – 80%	Central 15-foot traffic area covered; 30 – 69% of rubber vulcanized and bonded to pavement surface; 20 – 39% surface texture exposed.
Heavy	81 – 95%	70 – 95% of rubber vulcanized and bonded to pavement surface; will be difficult to remove; rubber has glossy or sheen look; 5 – 19% surface texture exposed.
Very Heavy	96 – 100%	Rubber completely vulcanized and bonded to surface; will be very difficult to remove; rubber has striations and glossy or sheen look; 0 – 4% surface texture exposed.

Note.- With respect to rubber accumulation, there are other factors to be considered by the airport operator; the type and age of the pavement, annual conditions, time of year, number of wide-body aeroplanes that operate on the runways, and length of runways. Accordingly, the recommended level of action may vary according to conditions encountered at the airport. This table is modified from Airport Services Manual Part 2, Pavement Surface Conditions, Appendix 2, Doc 9137-AN/898.

Chapter 6

TESTING OF POWER CHECK PAD ANCHORING SYSTEMS

6.1. Background. Most Air Force fighter aircraft use aircraft anchoring systems during power checks and routine maintenance procedures. When requested by the MAJCOMs, AFCEC tests anchors to determine their capability to safely support the loads imposed by these aircraft. AFCEC tests only existing power check pad anchors that were originally designed to withstand loads associated with F-4 operations: AFCEC does not test Hush House anchors or high-capacity trim-pad anchors. If new high-capacity trim-pad anchors are constructed as specified in applicable UFCs or Engineering Technical Letters (ETLs), testing is not required; however, if there are quality concerns, proof loading to ensure that new anchors meet operational requirements should be included in the project documents. Emergency requests for testing of new anchors must be approved by the AFCEC Director and requires funding by the MAJCOM/base. **(T-1).** Equipment and inspection and testing procedures are detailed in Appendix G of UFC 3-260-03. The base provides a forklift or crane for the tests.

6.2. Testing Schedule. AFCEC develops an annual anchor testing program based on MAJCOM requirements. The annual data call process is described in section 4.3.

6.3. Anchor Testing Report. After completion of field testing and data analysis, AFCEC publishes an anchor testing report. The report documents the equipment and procedures used to test the anchors and includes proof load data. Usage recommendations are provided based on the anchors performance during the proof-load test. Examples of the recorded data and the affidavit are provided in UFC 3-260-03, Appendix G.

6.4. Report Distribution. AFCEC distributes the anchor test report to the appropriate base and MAJCOMs and maintains files at AFCEC.

Chapter 7

PAVEMENT CONDITION INDEX SURVEY PROGRAM

7.1. Program Management. AFCEC manages the Air Force pavement condition index (PCI) survey program. Responsibilities include maintaining files of all previous PCI survey reports for each base, maintaining contracts for conducting PCI surveys, funding, scheduling, and monitoring contract PCIs, performing quality assurance, and updating the PAVER pavement management system and applicable reference documents.

7.1.1. CETSC manages the Air Force pavement condition index (PCI) survey program for ANG locations. Responsibilities include maintaining PCI survey reports, conducts PCI surveys, and updates the PAVER pavement management system and applicable reference documents.

7.1.2. CETSC provides PCI survey reports and updated PAVER management system files to AFCEC upon completion.

7.2. Reference Documents. PCI surveys are accomplished in accordance with the most current version of the following documents:

7.2.1. ASTM D5340 and UFC 3-260-16FA, *Airfield Condition Survey Procedures*.

7.2.2. ASTM D6433, *Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys*.

7.2.3. ASTM E1926, *Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements* when surveys are conducted using automated inspection systems.

7.3. Contract Procedure. AFCEC publishes an updated 16-year PCI survey schedule in an annual call letter. Bases can request changes to the schedule by responding to the call and providing justification for the change. Once the PCI survey schedule is updated, AFCEC develops the statement of work, government cost estimates, and other contracting documents. After receiving funding, the AFCEC program manager (PM) works with the contracting officer to award a task order under a pre-negotiated contract. The PM works with both the customer and the contractor to ensure that the contractor has the latest structural pavement evaluation data and other required information. AFCEC coordinates the overall survey schedule with the bases, and once confirmed, monitors progress and addresses any issues raised by the base or contractor. Once the draft report is published, the PM reviews it for technical and contractual adequacy and works with the contractor and base to reconcile issues, ensure that applicable comments are incorporated, and ensure that the effort is completed within schedule.

7.4. Report Content. The statement of work outlines the content required in the report. The PM works with the AFCEC Airfield Pavement Evaluation (APE) team, contractors, and Reserve PCI teams to ensure that reports are structured the same and meet current standards for content.

7.4.1. **Field Survey Inbrief.** Provide an entry briefing to the BCE project officer and other base officials, as arranged by the project officer. This inbrief should explain the survey procedures and describe the base support needed to complete the evaluation.

7.4.2. **Field Survey Outbrief.** Provide an exit briefing to the BCE project officer and other base officials, as arranged by the project officer. This outbrief should summarize the survey results and provide a general impression of pavement maintenance requirements.

7.4.3. **Reports.** The survey team produces a report for the airfield and/or road network according to the statement of work for contracts and according to current report standards for the APE or Reserve Teams. Contractors shall deliver, the report in hard copy and pdf, the PAVER database, all mapping for the survey, the PAVER database, all photo documentation, and all source documents created for the report. All reports are stored on the AFCEC network drive and the report pdf, mapping, and database are posted on the AFCEC Pavement Report Website at **https://tyndall.eim.acc.hedc.af.mil/apps/afcec/Pavement%20Reports/default.aspx**. The final reports must also be established as part of the official records file plan. **(T-0).**

Chapter 8

PAVEMENT ENGINEERING ASSESSMENT STANDARDS

8.1. EA for Airfields. An EA is used to help prioritize or rank proposed M&R pavement projects. The components of the EA are also used in the Transportation and Airfield Pavements (TNAP) business rules to compute the probability of failure (PoF) which is in turn used to score / prioritize projects on the integrated priority list (IPL).

8.1.1. **EA Criteria.** Apply the criteria in section 8.1.5 to determine or validate a section/branch rating of Adequate, Degraded, or Unsatisfactory.

8.1.2. **Project Priorities.** Apply the criteria in section 8.1.6 to set priorities for projects on sections/branches within each impact rating category.

8.1.3. **Numerical Rating System.** The criteria in section 8.1.8 can be used to establish a numerical rating for pavement systems or entire airfields to allow comparison throughout a MAJCOM and to assess the potential impact of projects.

8.1.4. **Rating Factors.** The factors used to determine EAs or ratings are the PCI, Friction Index (runway pavements only), Structural Index, and Foreign Object Damage (FOD) Index.

8.1.4.1. **PCI.** The PCI is a numerical rating (on a scale of 0 to 100) determined by a visual pavement survey based on procedures in ASTM D5340, ASTM D6433, and UFC 3-260-16FA. Refer to the most current version of the ASTM publications.

8.1.4.1.1. This AFI establishes a standard color code for the seven condition codes described in ASTM D5340 and also for corresponding simplified and cursory PCI rating system used when performing contingency evaluations. Air Force PCI surveys are typically conducted to the 95% confidence level and uses the seven-tier rating system depicted in **Figure 8.1.** A simplified PCI uses the same seven-tier scale, but only requires the minimum number of sample units outlined in the ASTM. The cursory survey is based on a representative sample that is less than the minimum outlined in the ASTM and uses Good, Fair, and Poor rating categories.

8.1.4.1.2. **Table 8.1.** provides a more detailed description of the PCI rating categories and their associated distress levels and probable maintenance requirements. **Figure 8.1.** shows the standard/simplified and cursory PCI rating scales. **Table 8.1** and **Table 8.2** describe the PCI ratings and associated M&R required to increase the PCI. **Table 8.3** displays the EA ratings and associated PCI values.

Figure 8.1. PCI and Simplified PCI Rating Scales.

<table>
<tr><th colspan="3">Standard/Simplified PCI</th><th colspan="3">Cursory PCI</th></tr>
<tr><td>Green</td><td>Good</td><td>86-100</td><td rowspan="2">Green</td><td rowspan="2">Good</td><td rowspan="2">75-100</td></tr>
<tr><td>Bright Green</td><td>Satisfactory</td><td>71-85</td></tr>
<tr><td>Yellow</td><td>Fair</td><td>56-70</td><td>Yellow</td><td>Fair</td><td>55-70</td></tr>
<tr><td>Rose</td><td>Poor</td><td>41-55</td><td rowspan="4">Red</td><td>Poor</td><td>40-55</td></tr>
<tr><td>Red</td><td>Very Poor</td><td>26-40</td><td rowspan="3">Poor
<40</td><td rowspan="3">0-40</td></tr>
<tr><td>Dark Red</td><td>Serious</td><td>11-25</td></tr>
<tr><td>Light Gray</td><td>Failed</td><td>0-10</td></tr>
</table>

Table 8.1. Definition of Standard/Simplified PCI Ratings.

PCI Index	PCI Rating		Descriptions
86 - 100	**Green**	Good	Pavement has minor or no distresses and will require only routine maintenance.
71 - 85	**Bright Green**	Satisfactory	Pavement has scattered low-severity distresses that should require routine maintenance.
56 - 70	**Yellow**	Fair	Pavement has a combination of generally low- and medium-severity distresses. Near term M&R needs may range routine to major.
41 - 55	**Rose**	Poor	Pavement has low-, medium-, and high-severity distresses that probably cause some operational problems. Near term M&R needs should range from routine to reconstruction.
26 - 40	**Red**	Very Poor	Pavement has predominantly medium- and high-severity distresses causing considerable maintenance and operational problems. Near-term M&R needs will be intensive.
11 - 25	**Dark Red**	Serious	Pavement has mainly high-severity distresses that cause operational restrictions. Repair needs are immediate.
0 - 10	**Light Gray**	Failed	Pavement deterioration has progressed to the point that safe aircraft operations are no longer possible. Complete reconstruction is required.

Table 8.2. Definition of Cursory PCI Ratings.

PCI Index	Cursory Rating		Cursory Definition
71 - 100	Green	Good	Pavement should only require routine maintenance and have few, scattered low-severity distresses.
56 - 70	Yellow	Fair	Pavement has a combination of generally low- and medium-severity distresses. Near-term M&R needs should be routine to major.
41 - 55	Red	Poor	Pavement has low-, medium-, and high-severity distresses that probably cause some operational problems. Near term M&R needs should range from routine to reconstruction.
0 - 40		Poor ≤ 40	Pavement has a number of medium-, and high-severity distresses that may require intensive maintenance and frequent repairs to support aircraft operations.

Table 8.3. EA PCI Criteria.

PCI Index	EA Rating
71–100	Adequate
56–70	Degraded
0–55	Unsatisfactory

8.1.4.2. **Friction Index.** AFCEC conducts tests to determine the friction characteristics of runways and compiles the results in a runway friction characteristics report for a given base. **Chapter 5** of this AFI outlines the details of when and how these tests are conducted and reports. The Friction Index for a section is equal to the Friction Index of the segment comprising the section. If the section is composed of more than one segment, assign the lowest of the segment friction indices to the section. Based on the Friction Index assigned to the section, a corresponding friction rating can be assigned using **Table 8.4**, which correlates friction indices from different friction measuring equipment to friction ratings. **The friction ratings in Table 8.4 are to be used to rank and compare projects and do not correspond to the guidance in FAA AC 150/5320-12C.** Because rubber deposits can lower the measured friction values, the truest measure of a pavement's friction characteristics is obtained if testing is accomplished shortly after completion of rubber removal. Therefore, to the maximum extent possible, friction testing should be scheduled as soon as possible following completion of a rubber removal project.

Table 8.4. Friction Index and Friction Rating Scales.

Friction Rating	Friction Index 40 mph (65 km/h) Nominal Test Speed, Unless Noted [10]										
	RCR[1]	Grip Tester[2]	JBI[3]	Mu-Meter	Surface Friction Tester[4]	Runway Friction Tester[5]	Bv-11 Skiddo-Meter[4]	Decel Meters[6]	Locked Wheel Devices[7]	IMAG[8]	ICAO Index[9]
Good	>17	>0.49	>0.58	>0.50	>0.54	>0.51	>0.59	>0.53	>0.51	>0.53	5
Fair	12–17	0.34–0.49	0.40–0.58	0.35–0.50	0.38–0.54	0.35–0.51	0.42–0.59	0.37–0.53	0.37–0.51	0.40–0.53	3–4
Poor	11	0.33	0.39	0.34	0.37	0.34	0.41	0.36	0.36	0.40	1–2

Notes:

1. RCR (runway condition rating): Decelerometer reading x 32 obtained at 25 mph (40 km/h)
2. Measurements obtained with smooth ASTM tire inflated to 20 psi (140 kilopascals [kPa])
3. JBI: James Brake Index obtained at 25 mph (40 km/h)
4. Measurements obtained with grooved aero tire inflated to 100 psi (690 kPa)
5. Measurements obtained with smooth ASTM 4- by 8-inch (102- by 203-millimeter) tire inflated to 30 psi (210 kPa)
6. Decelerometers include Tapley, Bowmonk, and electronic recording decelerometer at 25 mph (40 km/h)
7. ASTM E274, *Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire*, skid trailer and ASTM E503, *Standard Test Methods for Measurement of Skid Resistance on Paved Surfaces Using a Passenger Vehicle Diagonal Braking Technique*, diagonal-brake vehicle equipped with ASTM E524, *Standard Specification for Standard Smooth Tire for Pavement Skid-Resistance Tests*, smooth test tires inflated to 24 psi (170 kPa)
8. IMAG: Trailer device (manufactured in France) operated at 15 percent slip; grooved PIARC tire inflated to 100 psi (690 kPa)
9. ICAO: International Civil Aviation Organization index of friction characteristics
10. A wet runway produces a drop in friction with an increase in speed. If the runway has good texture, allowing the water to escape beneath the tire, then friction values are less affected by speed. Conversely, a poorly textured surface produces a larger drop in friction with an increase in speed. Friction characteristics can be further reduced by poor drainage due to inadequate slopes or depressions in the runway surface.

8.1.4.3. **Structural Index.** The Structural Index is a ratio of Aircraft Classification Number of the critical aircraft that operates on the airfield to the Pavement Classification Number (ACN/PCN) for a section. The ACN represents the impact a particular aircraft has on the pavement. The PCN represents the capability of the pavement to support an aircraft. AFCEC conducts structural evaluations for Air Force bases and for each evaluation publishes an airfield pavement evaluation report containing the PCN for each pavement section. The airfield pavement evaluation report also contains ACN data on certain aircraft (i.e., critical aircraft from each of the standard aircraft group indices as defined in **Chapter 4**). Additional ACN data are available from AFCEC's *Aircraft Characteristics for Airfield Pavement Design and Evaluation* report; USACE ETL 1110-3-394, *Aircraft Characteristics for Airfield-Heliport Design and Evaluation*; FAA AC 150/5335-5, *Standardized Method of Reporting Airport Pavement Strength PCN*; and the Pavement-Transportation Computer Assisted Structural Engineering (PCASE) computer program. Data from the latest AFCEC airfield pavement evaluation report can be used to determine the Structural Index and corresponding structural rating for each pavement section. (**Note:** Do not compute a Structural Index for overruns.) Different aircraft may be used to determine the ACN for different sections based on a base's mission and traffic patterns. An ACN/PCN ratio less than 1.10 is classified as Good, a ratio between 1.10 and 1.40 is classified as Fair, and a ratio greater than 1.4 is classified as Poor. The structural ratings of each section can be displayed on a color-coded airfield layout map, using green for the corresponding rating of Good, yellow for Fair, and red for Poor. **These ratios and ratings are to be used for comparison and prioritization only; they are not to be used to determine and report capability to support aircraft.**

Note: Some airfield pavement evaluation reports contain two sets of PCN values, one for normal conditions and one for the frost-melt or thaw-weakened period. In such instances, the Structural Index determination should be based on the reported PCN values for normal conditions.

8.1.4.4. **FOD Index.** A FOD Index can be determined using the PCI survey data. The FOD Index is determined from the PCI calculated by considering only the distresses/severity levels capable of producing FOD as presented in **Tables 8.4** and **8.5.** In calculating the PCI for determining the FOD Index, note that a multiplier, or modification factor, of 0.6 is applied to the deduct value for alligator cracking, and a multiplier, or modification factor, of 4.0 is applied to the deduct value for joint seal damage. The FOD Index equals ($100-PCI_{FOD}$) and can be calculated using PAVER.

Table 8.5. Distress List for ACC Pavements.

Distress Type	Severity Levels (L = Low, M = Medium, H = High)
Alligator Cracking (modification factor: 0.6)	L, M, H
Block Cracking	L, M, H
Jet Blast Erosion	n/a
Joint Reflection Cracking	L, M, H
Longitudinal and Transverse Cracking	L, M, H
Oil Spillage	n/a
Patching	M, H
Raveling and Weathering	L, M, H
Shoving	M, H
Slippage Cracking	n/a

Table 8.6. Distress List for PCC Pavements.

Distress Type	Severity Levels (L = Low, M = Medium, H = High)
Blow Up	L, M, H
Corner Break	L, M, H
Durability Cracking	M, H
Linear Cracking	L, M, H
Joint Seal Damage (modification factor: 4.0)	L, M, H
Small Patching	L, M, H
Large Patching	L, M, H
Popouts	n/a
Pumping	n/a
Scaling	L, M, H
Shattered Slab	L, M, H
Joint Spalling	L, M, H
Corner Spalling	L, M, H

8.1.4.5. **FOD Potential Rating Scale.** A FOD Potential Rating scale ranging from 0 to 100 can be used to indicate the potential for FOD problems. **Figure 8.2.** shows a numerical FOD Potential Rating scale and corresponding descriptive categories. The FOD Potential Rating depends on the type of aircraft using the pavement, the type of pavement surface (asphalt or concrete), and the FOD Index. The FOD Index and the FOD Potential Rating should be determined from the most current PCI survey. Relationships between FOD indices and FOD potential ratings have been developed for F-16, KC-135, and C-17 aircraft; **Figures 8.3.** and **8.4.** show these relationships for asphalt and concrete pavements, respectively. These three aircraft were selected as a representative cross section in regards to engine height above the pavement surface and engine susceptibility to FOD (e.g., engine type, size, air flow, thrust). **Table 8.7.** shows the FOD Index ranges corresponding to the FOD Potential Ratings of Good, Fair, and Poor, as determined from **Figures 8.3.** and **8.4.** **Table 8.8** provides recommendations on which standard aircraft curve (i.e., F-16, KC-135, or C-17) to use when determining the FOD Potential Ratings for other aircraft. Different aircraft curves may be used to determine the FOD Potential Ratings for different sections based on a base's mission and traffic patterns. The FOD Potential Ratings can be displayed on a color-coded airfield layout map, using green for the corresponding rating of Good, yellow for Fair, and red for Poor.

Figure 8.2. FOD Potential Rating Scale.

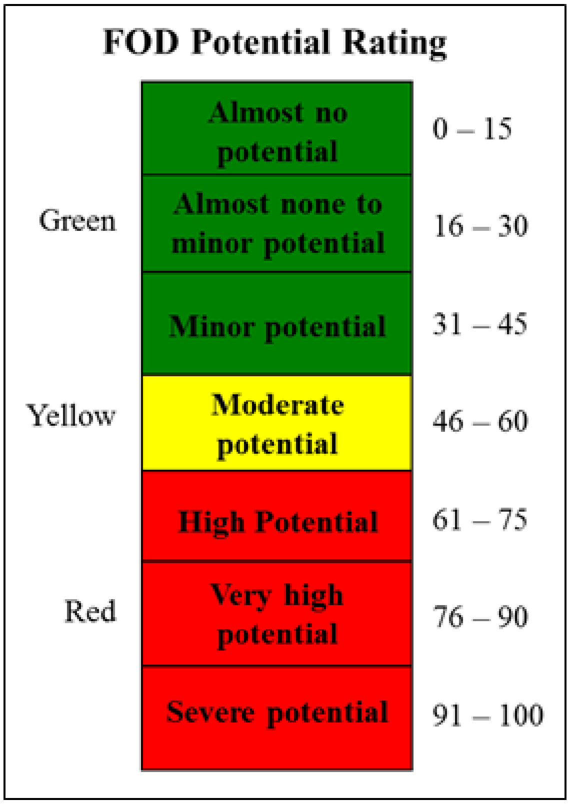


Figure 8.3. Relationships Between FOD Index and FOD Potential Rating for Asphalt Pavements.

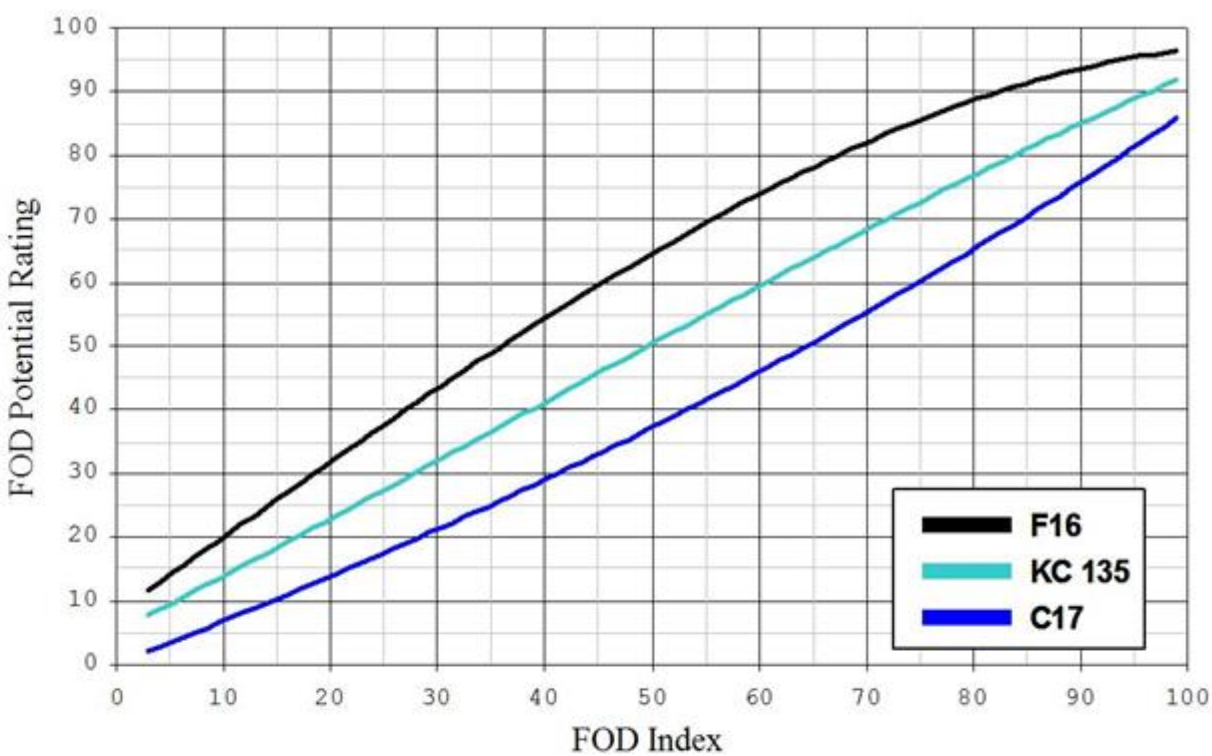


Figure 8.4. Relationships Between FOD Index and FOD Potential Rating for Concrete Payments.

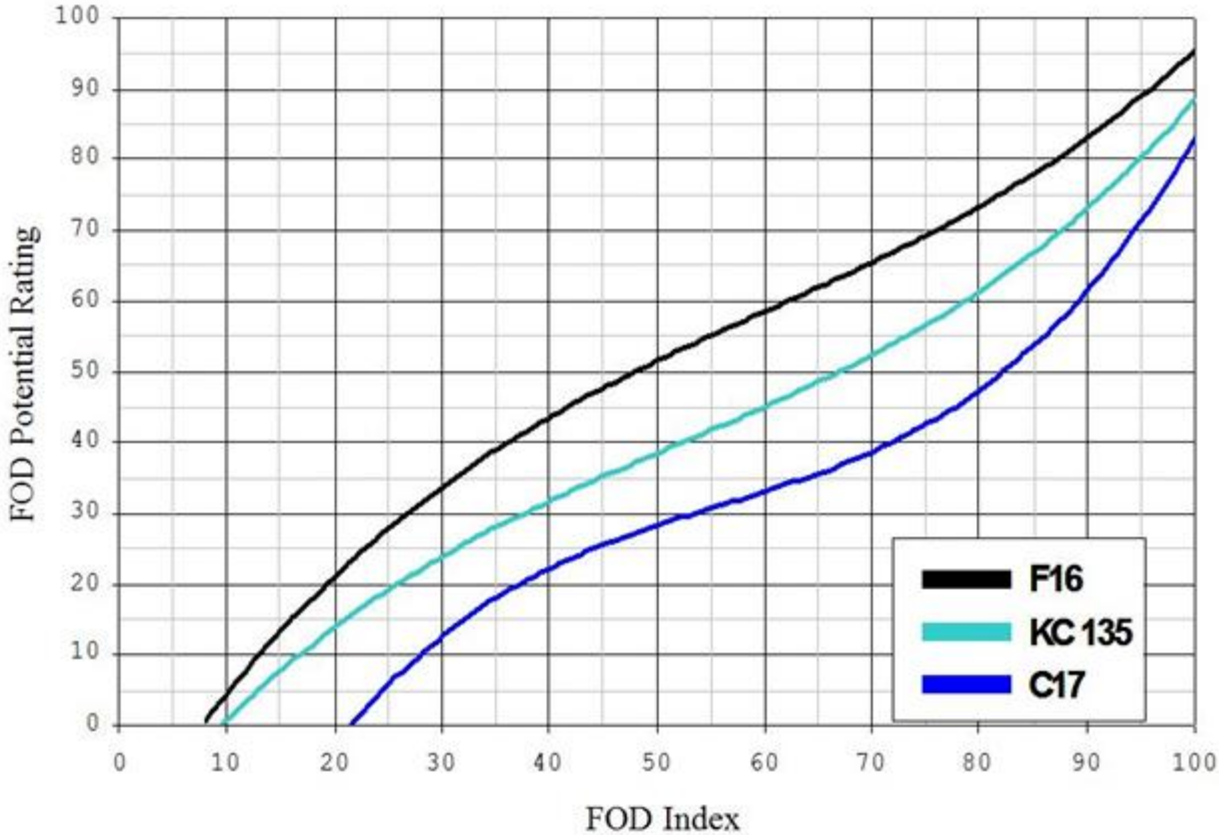


Table 8.7. FOD Index and FOD Potential Rating Scales.

FOD Potential Rating		FOD Index					
		F-16		KC-135		C-17	
		ACC	PCC	ACC	PCC	ACC	PCC
Good	0 – 45	0–32	0–41	0–44	0–60	0–59	0–77
Fair	46 – 60	33–45	42–62	45–60	61–78	60–75	78–89
Poor	61 –100	46–100	63–100	61–100	79–100	76–100	90–100

Table 8.8. Recommended FOD Curve Applicability for Various Aircraft.

Standard Aircraft	For Aircraft Listed Below, Use FOD Index/FOD Potential Rating Relationship Curve for Standard Aircraft (Left Column)
F-16	A-37, AT-38, F-15, F-22, F-35, T-37, T-38
KC-135	A-300, A-310, A-320, A-321, A-330, A-340, A-380, AN-124, B-1, B-2, B52, B-707, B-720, B-737, B-747, B-757, B-767, B-777, C-21, C-32, C38, C-40, C-135, DC-8, DC-10, E-3, E-4, E-8, EC-18, EC-135, IL-76, KC-10, L-1011, MD-10, MD-11, T-1A, T-43, VC-25, VC-137
C-17	A-10, B-717, B-727, C-5, C-9, C-12*, C-20, C-22, C-23*, C-27, C-37, C38, C-41, C-130*, C-295, CN 235, CV-22, DC-9, MC-12, MD-81, MD82, MD-87, MD-90, MV-22*, P-3*, RC-26, RQ-4, T-6*
* denotes turboprop- or turboshaft-equipped aircraft	

8.1.5. **Determining the EA.** This section describes a procedure for determining the EA for any airfield pavement section or branch (i.e., runway, apron, or taxiway) based on four factors: PCI, Friction Index (runway pavements only), Structural Index, and FOD Index.

8.1.5.1. **Step One: Determine Indices.** Determine the appropriate PCI, Friction Index (runway pavements only), Structural Index, and FOD Index for each pavement section.

8.1.5.1.1. **PCI.** Review the most recent airfield PCI survey report and determine the PCI for each pavement section. Rate the section in accordance with **Figure 8.1** and the instructions in paragraph 8.1.4.1.

8.1.5.1.2. **Friction Index.** Review the most recent AFCEC runway friction characteristics report for the base to determine the skid/hydroplaning potential of runway pavements. Divide the runway into 500-foot-long (152-meter-long) segments and determine the Friction Index of each segment. Correlate the segments to pavement sections and determine the Friction Index for each section. Rate the sections in accordance with **Table 8.4** and the instructions in paragraph 8.1.4.2.

8.1.5.1.3. **Structural Index.** Review the latest AFCEC airfield pavement evaluation report for the base and determine the Structural Index of each section. When performing ACN/PCN calculations, use an ACN for the **most critical** mission aircraft on a given section at the aircraft's **standard** takeoff weight and the published PCN based on 50,000 passes of a C-17. (**Note:** Different aircraft may be used in the calculations for different sections, such as when a particular section is used only by fighter aircraft while other sections receive a mix of traffic that includes heavier aircraft.) Rate the section in accordance with the instructions in paragraph 8.1.4.3. **Base engineers should consult with Base Operations to determine the critical mission aircraft and standard takeoff weight.**

8.1.5.1.4. **FOD Index.** Determine the FOD Index using the PCI survey data. The FOD Index is determined from the PCI calculated by considering only the distresses/severity levels capable of producing FOD. Determine the FOD Potential Rating for each pavement section based on the appropriate aircraft and in accordance with **Figures 8.3.** and **8.4.**, **Table 8.7.**, and the instructions in paragraph 8.1.4.4. (**Note:** Different aircraft may be used in determining the FOD Potential Ratings for different sections, such as when a particular section is used only for parking transport aircraft while other sections receive fighter aircraft.).

8.1.5.2. **Step Two: Determine EAs for Each Airfield Section.** EAs of Adequate, Degraded, or Unsatisfactory are assigned to each airfield section based on the criteria in **Table 8.9.** All rating factors meet the criteria; i.e., if all factors do not meet the criteria, the section rating is assigned based on the lowest factor rating. For example, a runway section would be rated Adequate only if the PCI is $\geq$ 71; and the Friction Index is > 0.49; and the Structural Index (ACN/PCN) is less than 1.10; and the FOD Potential Rating is $\leq$ 45.

Table 8.9. EA Criteria.

Assessment/Rating Category	PCI	Friction Index (Runway Pavements Only)	Structural Index	FOD Potential Rating
Adequate	71–100	> 0.49*	< 1.10	0–45
Degraded	56–70	0.34–0.49*	1.10–1.40	46–60
Unsatisfactory	0–55	< 0.34*	> 1.40	61–100
*Applies to GripTester at 40 mph (65 km/h) only. For other testing equipment, use the values corresponding to the ratings of Good, Fair, and Poor in **Table 8.4**.				

8.1.5.3. **Step Three: Determine the EA for a Branch or Project Requirement.** The EA can be determined for a branch or project requirement by computing the weighted area average PCI for the branch or project, Friction Index (runway pavements only), Structural Index, and FOD Potential Rating (optional) for each section and comparing the values to the criteria in **Table 8.9**. An example of computing a weighted average PCI is shown in section 8.1.8. **Table 8.10** shows an example of computing an EA for a runway, where Section R01A is 150 by 1000 feet (46 by 305 meters), Section R02C is 150 by 8000 feet (46 by 2,438 meters), Section R03A is 150 by 500 feet (46 by 152 meters), and Section R04A is 150 by 500 feet (46 by 152 meters). Comparing the weighted values in **Table 8.10** to the criteria in **Table 8.9**, the EA for the runway is Degraded, the lowest rating of the four factors.

Note: The weighted average Structural Index can result in a Degraded or Unsatisfactory rating for a branch or project even though the PCI and other factors are rated Adequate. In this situation, examine the individual Degraded section(s) to determine if they can support the mission requirements. (Use the AGLs table in the latest AFCEC pavement evaluation report.) If the mission requirements are met, rate the branch/project as Adequate.

Table 8.10. EA Example.

Section	Area, square feet (square meters)	PCI	Friction Index (GripTester at 40 mph [65 km/h])	Structural Index	FOD Potential Rating	EA
R01A	150,000 ft^2 (13,935 m^2)	78	0.55	0.88	35	Adequate
R02C	1,200,000 ft^2 (111,484 m^2)	87	0.40	0.88	25	Degraded
R03A	75,000 ft^2 (6,968 m^2)	76	0.40	1.25	39	Degraded
R04A	75,000 ft^2 (6,968 m^2)	65	0.40	1.50	63	Unsatisfactory
Weighted Values		**85 (Adequate)**	**0.42 (Degraded)**	**0.93 (Adequate)**	**29 (Adequate)**	**Degraded**

8.1.5.4. **Step Four: Report the EAs by Section and Branch.** It is also recommended that the results be displayed on a color-coded airfield layout plan, with green indicating Adequate, yellow indicating Degraded, and red indicating Unsatisfactory sections. An example airfield layout plan illustrating EAs by section is shown in **Figure 8.5**, while EAs by branch (i.e., based on weighted section values) are shown in **Figure 8.6**.

Figure 8.5. Sample Airfield Layout Plan Rated by Section.

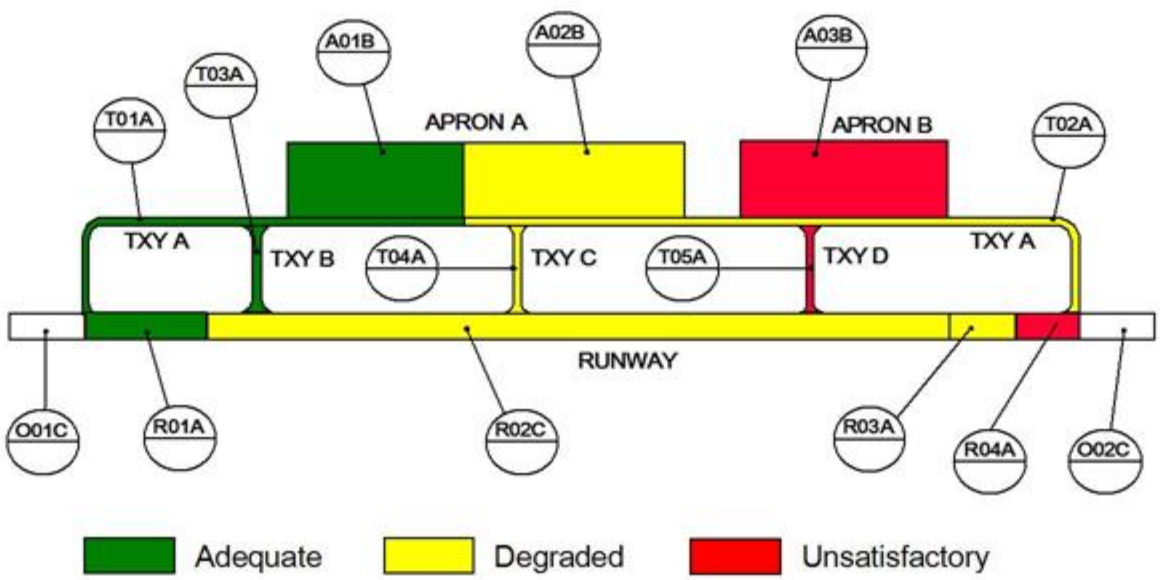
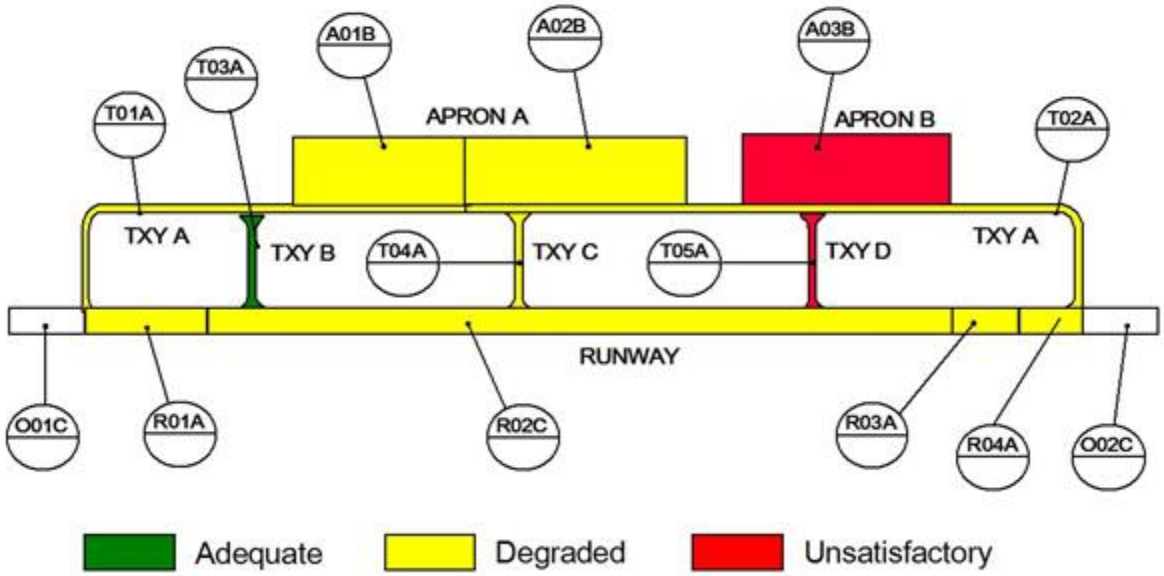


Figure 8.6. Sample Airfield Layout Plan Rated by Branch.



8.1.6. **Project Prioritization.** The following procedure outlines a method for objectively establishing priorities for projects that fall into the same assessment category (i.e., Adequate, Degraded, or Unsatisfactory).

8.1.6.1. **Procedure.** Determine the PCI, Friction Index, Structural Index, and FOD Potential Rating (optional) for the section related to each project. Use **Figure 8.7.** to determine the deduct values for the Friction Index, Structural Index, and FOD Potential Rating (optional). Friction deduct charts are shown for both the Mu-Meter and the GripTester. These deduct values may be capped at a maximum value of 10 for data that falls outside the ranges of values depicted. Subtract each deduct value from the PCI to determine a priority order (lowest numerical result ranks first in priority).

8.1.6.2. **Example.** Assume that three runway sections fall within the Degraded category as determined by the criteria in **Table 8.9.** Pertinent information for determining the section project prioritization for this example is shown in **Table 8.11.**

Figure 8.7. Deduct Values for Friction Index, Structural Index, and FOD Potential Rating.

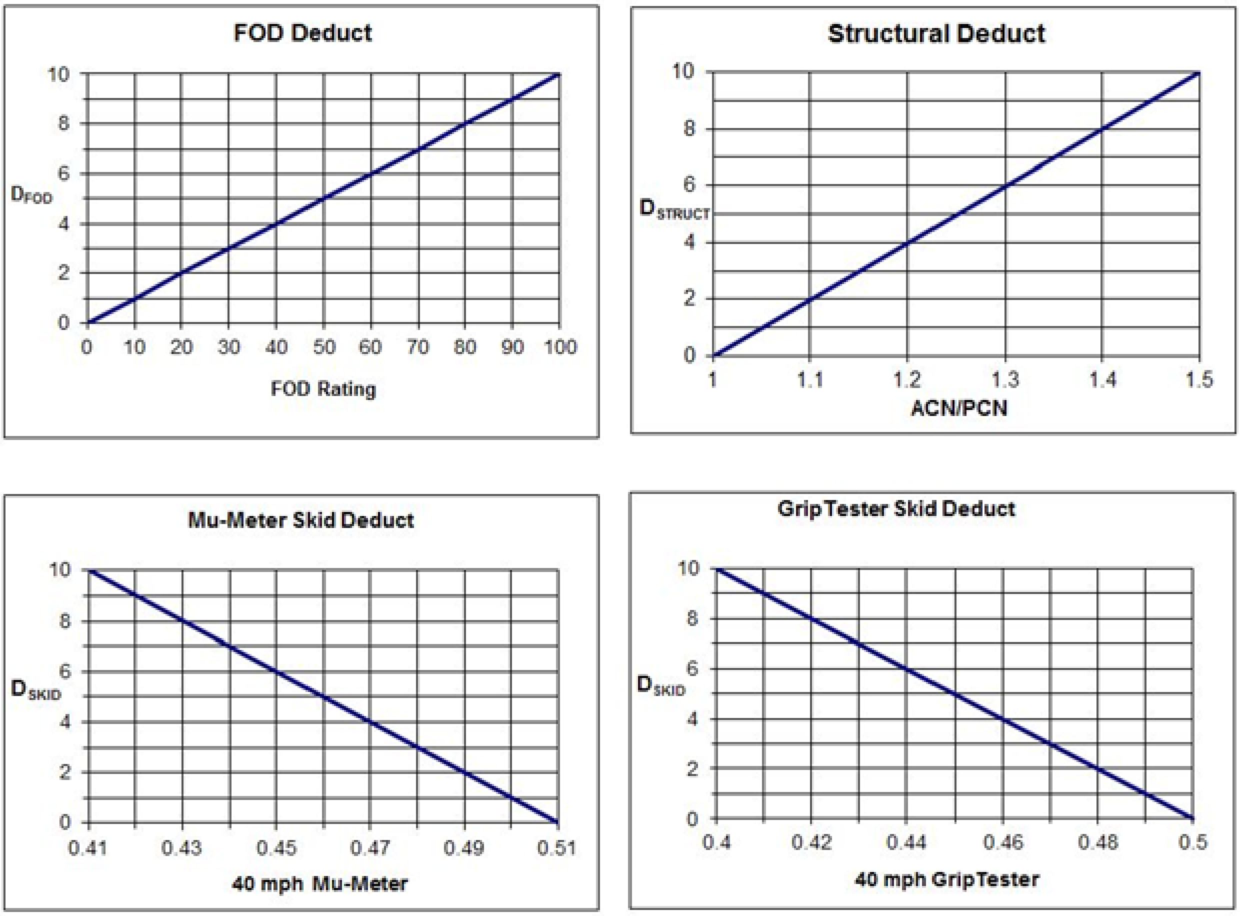


Table 8.11. Determining Funding Priority.

Section	PCI	Friction Index (GripTester)	FOD Potential Rating	Structural Index
R11A	75	0.48	10	1.4
R12A	56	0.43	30	1.3
R13A	56	0.43	20	1.3
Rating Calculations				
R11A	75−2−1−8 = 64			
R12A	56−7−3−6 = 40			
R13A	56−7−2−6 = 41			
The priority for funding is R12A, then R13A, then R11A.				

8.1.7. **Combining Sections.** When sections are combined to form projects, use an area-weighted process for determining the rating. For instance, if Sections R12A and R13A in **Table 8.11.** were included in a single project, the combined rating would be:

$$\text{Rating (Combined)} = \frac{\text{Rating R12A(Area R12A)} + \text{Rating R13A(Area R13A)}}{\text{Area R12A} + \text{Area R13A}}$$

8.1.8. **Numerical Rating System.** This process can be used to rate the general "health" of all facilities, including pavements, on a numerical rating scale. This section describes a procedure for calculating a pavement rating using a weighted PCI. A weighted PCI can be calculated manually or by using PAVER:

8.1.8.1. Assume a 10,000- by 150-foot (3,048- by 46-meter) runway comprised of the sections described in **Table 8.12**.

Table 8.12. Numerical Rating System Example.

Section	Dimensions	PCI
R21A	1,000 by 150 feet (305 by 46 meters)	78
R22C	8,000 by 150 feet (2,438 by 46 meters)	70
R23A	500 by 150 feet (152 by 46 meters)	54
R24A	500 by 150 feet (152 by 46 meters)	52

8.1.8.2. The manual computation:

$$\text{Weighted PCI} = \frac{\text{R21A PCI(R21A Area)} + \text{R22C PCI(R22C Area)} + \text{R23A PCI(R23A Area)} + \text{R24A PCI(R24A Area)}}{\text{R21A Area} + \text{R22C Area} + \text{R23A Area} + \text{R24A Area}}$$

$$\text{Weighted PCI} = \frac{78(1000\times150) + 70(8000\times150) + 54(500\times150) + 52(500\times150)}{(1000\times150) + (8000\times150) + (500\times150) + (500\times150)}$$

Weighted PCI = 69 = health of runway

8.1.9. **Assessing Value Added.** The procedure above can also be used to determine "value added" to a facility by a project. For example, assume an M&R project raises the PCI of R23A and R24A to 80 without affecting any of the other indices. The new rating for the runway would be 71.8; therefore, the project increased the health of the runway by 2.8 points.

8.1.10. **Rating Scales.** It is possible to adjust the scale for rating facility health. For example, using a range of 85 to 100 for the rating of Good may be desirable. This can be accomplished by applying a proportioning operation to the weighted PCI (see **Table 8.13.**).

Table 8.13. Proportioning Operation Applied to the Weighted PCI.

Rating	Weighted PCI	Proportioning Operation	Numerical Rating
Good	100 71	→ ([PCI-71] x [15/30])+85 →	100 85
Fair	70 56	→ (PCI-56)+70 →	84 70
Poor	55 0	→ (PCI-70/55) →	69 0

Chapter 9

ASSET MANAGEMENT

9.1. Background. The goal of Asset Management is to effectively manage infrastructure. AFPD 32-10 states that the Air Force will "provide and retain the minimum number of installations and facilities necessary to effectively support Air Force missions and people at the lowest life-cycle cost and in a sustainable way..." To accomplish this goal, infrastructure was divided into five activities: transportation networks, utilities, facilities, waste management, and natural infrastructure. The transportation networks include airfield and roadway pavements, vehicle parking areas, curbs and gutters, bridges, sidewalks, airfield and traffic markings, signals and signs, rails, docks, and piers.

9.2. Activity Management Plan (AMP). AMPs are developed for each major CE activity to include Transportation and Airfield Pavement (TNAP) Networks. AMPs include information on Real Property inventory, Levels of Service (LOS), Key Performance Indicators (KPI), and the planned investments (projects/requirements) identified to achieve the required LOS. The Pavement Management Plan (PMP) is a component of the AMP that outlines the maintenance and repair requirement for all base pavements. The PMP will have subcomponents for both airfields and for roads and parking pavements. Both of these plans can be simply expressed as a document that specifies the following to inform base leadership:

a) When maintenance or repair is needed.
b) What maintenance or repair activities are to be performed.
c) How the work is to be accomplished.
d) What is the cost for the work and what is the risk if the work is not accomplished.

At a minimum, the PMP includes a prioritized list of work requirements and projects for execution in-house or by contract with location, quantity, estimated cost, and the benefit / risk associated with performing or not performing the work.

9.3. Developing the PMP. As described in **Chapter 2**, AFCEC has the responsibility to centrally fund and manage the structural evaluation and PCI survey program for the Air Force. AFRC supports AFRC owned installations and CETSC supports ANG owned installations in development of Pavement Management Plans (PMP). This program collects the bulk of the data base civil engineers need to develop PMPs. The PMP starts with a list of pavement maintenance and repair requirements from the AFCEC report. The PCI generated by PAVER (the DoD's pavement management system) and the Engineering Assessment data from the report are the core elements that base engineers use to identify and prioritize these requirements. The base uses this data in conjunction with the structural pavement evaluation and construction history data to translate these prioritized requirements into properly scoped in-house work plans and projects for contract execution to implement the PMP.

9.4. Pavement Maintenance and Repair Categories. The terminology traditionally used to describe pavement maintenance and repair is a bit different than used for other asset types, which sometimes causes confusion. Following are definitions for each category:

9.4.1. **Preventive Maintenance.** This is a program of activities that preserves the investment in pavements, reduces the rate of degradation due to specific distresses, extends pavement life, enhances pavement performance, and reduces mission impact. Preventive

Maintenance includes Localized Preventive Maintenance and Global Preventive Maintenance. Both are performed on pavements that are above the Critical PCI and are intended to maintain good pavements in good condition, at minimal cost.

9.4.1.1. **Localized Preventive Maintenance** . Localized PM consists of maintenance actions performed on pavement at the location of individual distresses to slow down the rate of pavement deterioration. It differs from global preventive maintenance in that it typically is not applied to pavement outside of the location of the distress, whereas global preventive maintenance is applied to areas of the pavement that may not be distressed.

9.4.1.2. **Global Preventive Maintenance.** Global PM is used to retard or slow pavement deterioration. Generally, global PM is effective at the beginning of pavement life, and/or when the climatic-caused distresses have not started (or, in some cases, the severity is low or medium). Global PM may be performed in response to the appearance or progression of distress like Localized Maintenance, but is more commonly performed on a recurring schedule (i.e., at set time intervals) without regard for the distresses present. Examples of global PM include Micro- Surfacing, Slurry Seals, or Fog Seals.

9.4.2. **Major Maintenance and Repair (M&R).** This is defined as activities applied to the entire pavement section to correct or improve existing surface or structural conditions to meet functional requirements. Major M&R includes work like mill and overlay, structural overlays, selective slab replacement, and reconstruction. Traditionally it was assumed that the PCI value would be 100 after major M&R which is true for asphalt pavements, but not necessarily for concrete pavement. The current definition assumes the PCI will improve significantly, but not necessarily take it back to 100. The two categories of Major M&R are:

9.4.2.1. **Major M&R above critical PCI.** This is typically done to address a structural deficiency or some other operational issue. This option is rarely used; typically we will continue to do localized preventive maintenance at least until we reach the critical PCI to maximize the useful life of the existing pavement.

9.4.2.2. **Major M&R below critical PCI.** This is done after a pavement reaches the critical PCI. A pavement condition that has gone past the critical PCI has not failed and is still functional, but the effectiveness of preventive (operational) maintenance is diminished and less cost-effective.

9.4.3. **Operational Maintenance.** This is also referred to as safety maintenance, stop-gap maintenance, and breakdown maintenance. Operational Maintenance is performed to mitigate distresses on pavements that are below the Critical PCI to keep them operationally safe for use. The type of work performed is the same as what is done for preventive maintenance.

9.5. Critical PCI. This is the PCI value of a section at which the rate of deterioration significantly increases and cost effectiveness (return on investment) of preventive maintenance decreases. Critical PCI will depend on pavement type, pavement use, traffic level, and repair costs and is unique for each base. In 2016, PAVER is being configured to calculate the Critical PCI for each pavement section. Until this capability is in place, the Air Force will continue using a PCI of 70 as the default Critical PCI for primary pavements and 55 for secondary and tertiary pavements.

9.6. Pavement Rank. This is used to more accurately establish the priority of requirements. Pavement sections are assigned a rank of primary, secondary, and tertiary, or unused depending on how they are used and their criticality to the mission. Pavement ranks are established by AFCEC and the base for each pavement section according to the definitions outlined below. Ranks for road and parking pavements relate to road categories outlined in Surface Deployment and Distribution Command (SDDC) Manual on Uniform Traffic Control Devices. Pavement ranks are used to adjust the MDI for use in prioritizing requirements and computing the Consequence of Failure (CoF) which is in turn used to prioritize projects on the Integrated Priority List (IPL). Strict implementation of these rankings is critical to the ability to stratify and prioritize requirements and projects. The current version of the TNAP Business Rules which is available at **https://cs1.eis.af.mil/sites/ceportal/CEPlaybooks/AFCAMP/Pages/default.aspx**, outlines specific adjustment factors and computation process.

9.6.1. **Primary airfield pavements.** These are mission-essential pavements such as runways, parallel taxiways, main parking aprons, arm-disarm pads, alert aircraft pavements, and overruns (when used as a taxiway or for takeoff). In general, only pavements that are used by assigned aircraft on a daily basis are considered primary.

9.6.2. **Primary road and parking pavements.** These include arterials which are defined as a class of street serving a major movement of traffic not served by a freeway. This includes installation roads and streets that serve as the main distributing arteries for traffic originating outside and within an installation and that provide access to, thru, and between the various functional areas or collector or local streets that service mission critical facilities. Classification of vehicle parking areas as primary pavements should be restricted to those areas associated with access to mission-essential facilities, such as alert facilities, munitions facilities, and medical facilities.

9.6.3. **Secondary airfield pavements.** These are not used on a daily basis by assigned or transient aircraft. Examples include; ladder taxiways, parking areas not currently used by assigned mission aircraft, overflow parking areas, and overruns (when there is an aircraft arresting system present). In general, if a pavement is used by assigned or transient aircraft on a weekly basis, they should be considered secondary.

9.6.4. **Secondary road and parking pavements.** These include collector streets that gather and disperse traffic between the larger arterial highways and less important streets, that have intersections at grade, and that are equally important in providing traffic movement and access to abutting properties. In addition, most parking areas that support daily traffic on a base are considered secondary pavements, unless a specific mission dictates otherwise.

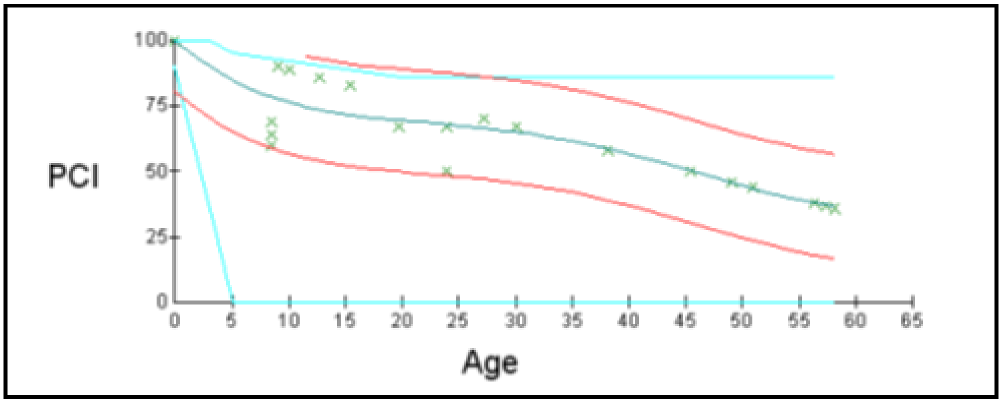
9.6.5. **Tertiary airfield pavements.** These include infrequently used pavements or those used by towed aircraft, such as maintenance hangar access aprons, aero club parking, wash racks, and overruns (when not used as a taxiway or to test aircraft arresting gear). In general, any pavement that does not support aircraft taxiing under their own power or is used on a monthly basis is considered a tertiary pavement.

9.6.6. **Tertiary road and parking pavements.** These include local streets that are streets or roads primarily for access to residence, business or other abutting property. Installation roads and streets that provide access from other collector roads and streets to individual units of facilities of a functional area are included in this category. Unsurfaced roads and abandoned in-place but usable roads are classified as tertiary. Any parking area that is not used on a daily basis or is excess to the standard facilities requirements is considered a tertiary pavement.

9.6.7. **Unused pavements.** These include any pavements that are inactive, abandoned or scheduled for demolition.

9.7. Rate of Pavement Deterioration. This is the rate at which a specific pavement at a specific location deteriorates over time. This rate is dependent on climatic conditions, pavement use and traffic level. Pavements at each base are grouped into families based on the pavement type, rank, and/or use in PAVER which computes deterioration rates (deterioration family curves) for each of these families. These deterioration rates are used to predict the future condition of pavements. An example family curve is shown below. The middle green curve represents the rate of deterioration; the outside red curves represent outlier boundaries which represent 1.96 Sigma on each side of the prediction curve. This equates to 95% of the data points being within the prediction curve envelope.

Figure 9.1. Typical Family Curve.



9.8. Work Planning. The PCI provides a key indicator of the level of maintenance and repair that should be accomplished. The PMP should outline in-house M&R work to be performed or projects that should be programmed before the pavement reaches the conditions described below.

a) Sections with a PCI greater than or equal to 71 require preventive maintenance or minor M&R.
b) Sections with a PCI of 56 to 70 require major and/or minor M&R.
c) Sections with a PCI of 41 to 55 require major M&R or reconstruction.
d) Sections with a PCI below 40 generally require reconstruction although depending on the pavement rank and use, Major M&R may be used to prolong the life of the pavement.

9.9. Localized Preventive Maintenance and Repair Policies. The Air Force has developed recommended localized maintenance and repair actions used to mitigate distresses and preserve airfield pavements above the Critical PCI as indicated in **Tables A2.1** and **A2.2** and in **Tables A2.3** and A2.4 for road and parking pavements. These policies are implemented in PAVER in system tables and consider the severity and extent of observed distresses. For example, using the PCI pavement distress evaluation terminology, the occurrence of joint seal damage in PCC pavements at the medium or high severity triggers the need for joint sealing.

9.10. Global Preventive Maintenance Policies. Global PM is used to retard or delay large-scale pavement deterioration. Currently, global PM for the Air Force is limited to the application of surface treatments to asphalt surfaces. Surface treatments are divided into two general applications; fog seals/rejuvenators and slurry seals/microsurfacing. Asphalt surface treatments include spray-applied materials such as liquid-only (fog seals) and liquid/sand mixtures. Microsurfacing and slurry seals are applied using a mixing unit and spreader box. When determining the frequency of global PM, the pavement's condition should serve as the primary determining factor. Generally, global PM is effective at the beginning of pavement life and/or when the distress severity is low. When used correctly, global PM prolongs pavement service life but the benefits can vary based on local environmental conditions and other factors. Local DOT or Airport practices can provide a good guide on the effectiveness of global maintenance. Following is a summary of global maintenance treatments installations should consider to extend the service life of pavements.

Table 9.1. Global Maintenance.

Treatment	Recommend AF Application	Estimated Increased Service Life	Approximate Cost
Microsurfacing and Slurry Seals	Roads and Parking	4 -8 yrs depending on current condition of pavement	$3 to $6 per SY (50% to 75% of cost of overlay)
Restorative (Fog) Seals	Airfields and Roads and Parking	1 to 3 yrs for pavement in good condition	$0.5 to $2 per SY

9.11. Requirements Prioritization: the same rule set outlined in the TNAP Business rules for scoring projects can be used to prioritize requirements. The Probability of Failure (PoF) and Consequence of Failure (CoF) are the components of a risk matrix that defines four categories of risk; High, Significant, Moderate, and Low. Specifics can be found in the current version of the TNAP Business Rules.

9.11.1. **PoF:** The PoF is determined based on the PCI in the year of execution with downward adjustments based on the FOD Potential Rating, Structural Index, and Friction Index described in **Chapter 8**, Engineering Assessment.

9.11.2. **CoF (Adjusted MDI):** The CoF is determined by the Mission Dependency Index (MDI) of the facility. A portion of the CoF value is determined based on MAJCOM input. The objective portion of the CoF is based on the MDI, which is determined based on the category code for the facility. However, since not all airfield pavements with a given category code are equally important, the MDI is adjusted using the pavement rank. Primary pavements have a multiplier of 1.0, Secondary have a multiplier of 0.9, and Tertiary have a multiplier of 0.6. Do not apply a multiplier for road and parking areas, just use the MDI.

9.11.3. **Savings to Investment Ratio (SIR):** Using the PoF and CoF tends to place a high priority on pavements with a low condition rating and a high CoF (worst first). One of the primary tenants of asset management is to optimize the life cycle cost of a facility by investing in preventive maintenance. New business rules are in development to place an emphasis on keeping our good pavements good.

9.12. Developing the Pavement Management Plan . PCI reports include a list of M&R requirements by section with a recommended year of execution based on the critical PCI, Branch Use, and Rank. This list of requirements will be prioritized using the PoF and Adjusted MDI as outlined in the business rules. Current (as of 2015) evaluation reports now include a table summarizing the PoF and Adjusted MDI for each section. However, it will take another four years before all published reports include these products. In the interim, the following process for developing the PMP from the tables and data in the published reports can be used. Note that PAVER is being modified to automate the PoF, Adjusted MDI, and SIR computations in 2016 which should facilitate the process:

9.12.1. **Generate PoF and Adjusted MDI Table:** This table will list the PoF and Adjusted MDI for each section. Download the PoF and Adjusted MDI template posted on the Transportation and Pavements site at this link: **https://cs3.eis.af.mil/sites/OO-EN-CE-A6/24048/OO-EN-CE-55/default.aspx**. Fill in the template by copying and pasting the data from Engineering Assessment (EA) Table in the report into the PoF and Adjusted MDI template. Detailed instructions are included with the template. Use the PoF and Adjusted MDI table to prioritize the sections that have the highest risk.

9.12.2. **Prioritize Work Requirements:** The PCI report includes tables that provide a list of preventive, global, stop-gap, and major maintenance and repair requirements for each section for each year. Use the PoF and Adjusted MDI table to prioritize these work requirements based on level of risk for each section.

9.12.3. **Refine Work Requirements:** The extrapolated distress report is used to refine the list of requirements and displays the distresses that have the highest deducts for each section. Place a higher priority on the distresses that have the highest deducts. In addition, apply the SIR guidance in the business rules to global and localized preventive maintenance requirements to ensure the PMP includes projects that have a high payback and reduce the life-cycle cost.

9.12.4. **Group Work Requirements:** PAVER makes recommendations on the year of execution of specific work requirements based on the projected condition, critical PCI, Branch Use, and Rank. The engineer must apply judgment in determining how best to group these requirements. For instance, a base would most likely not want to do a mill and overlay project on a portion of their runway every year for three years. These requirements would be grouped in a single project executed in one year.

9.12.5. **Determine Method of Execution:** The final phase in developing a PMP is determining and documenting the method of execution: what is executed in-house and what is executed by contract (project). Once defined, the base uses a pavement management plan with requirements prioritized and grouped for a specific method of execution. In-house work requirements typically are for preventive maintenance. The base can incorporate the requirements into preventive maintenance task lists for execution. If executed by project, the base should integrate requirements with those of other asset types e.g. drainage, lighting, etc. to ensure projects are scoped properly.

9.13. Validating Quantities and Scoping Work Plans and Projects: PCI surveys are conducted at a 95% confidence level. This means that a specified percentage of sample units are inspected to ensure that the reported PCI is plus or minus five points of the actual PCI. Once the base determines the areas that require work, the scope of that work, and the method of execution, bases will need to validate the quantities of the distresses to be repaired and to update these quantities, if required. This is the case whether the repairs are done in-house or by contract. Furthermore, in the case of major M&R, the base should use the Engineering Assessment data, work history, and structural evaluation data to ensure the project is scoped properly. AFCEC/COAT is available to provide support on specific project scoping questions.

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Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

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Prescribed Forms

None

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*, 22 September 2009

Abbreviations and Acronyms

AC—Asphalt Concrete

AC—Advisory Circular (FAA publication)

ACES—Automated Civil Engineer System

ACN—Aircraft Classification Number

AFCEC—Air Force Civil Engineer Center

AFCEC/COAP—Air Force Civil Engineer Center, Asset Visibility Division, Airfield Pavement Evaluation Branch

AFCEC/COAT—Air Force Civil Engineer Center, Asset Visibility Division, Transportation Branch

AFIMSC—Air Force Installation and Mission Support Center

AFI—Air Force Instruction

AFIT—Air Force Institute of Technology

AFR—Air Force Reserve

AFMAN—Air Force Manual

AFRC—Air Force Reserve Command

AGE—Aircraft Ground Equipment

AGL—allowable gross load

AMP—Activity Management Plan

ANG—Air National Guard

APE—Airfield Pavement Evaluation

ASTM—American Society for Testing and Materials

AutoCAD—Automated Computer Aided Drafting

BCE—Base Civil Engineer

CATCODE—Category Code

CBR—California Bearing Ratio

CETSC—Civil Engineer Technical Services Center

CFME—Continuous Friction Measuring Equipment

CIP—Common Installation Picture

COCOM—Combatant Command

CoF—Consequence of Failure

DCP—Dynamic Cone Penetrometer

DOD—Department of Defense

DTIC—Defense Technical Information Center

EA—Engineering Assessment

ERDC—USACE Engineer Research and Development Center

ESRI—Environmental Systems Research Institute

ETL—Engineering Technical Letter

FAA—Federal Aviation Administration

FAC—Facility Analysis Category

FGS—Final Governing Standard

ft^2—square feet

FOD—Foreign Object Damage

HQ AFCESA—Headquarters Air Force Civil Engineer Support Agency

GIS—Geographic Information System

GSU—Geographically Separated Unit

HWD—Heavy Weight Deflectometer

ICAO—International Civil Aviation Organization

ID—Identification

IT—Information Technology

IPL—Integrated Priority List

k—modulus of soil reaction

KPI—Key Performance Indicator

km/h—kilometers per hour

LOS—Level of Service

m^2—square meters

M&R—maintenance and repair

MAJCOM—major command

MDI—Mission Dependency Index

MILCON—military construction

mph—miles per hour

NASA—National Aeronautics and Space Administration

NGA—National Geospatial-Intelligence Agency

NOTAM—Notice to Airmen

OEBGD—Overseas Environmental Baseline Guidance Document

OPR—Office of Primary Responsibility

OSD—Office of the Secretary of Defense

PAVER—pavements management software used by DOD, government, and private industry

PCASE—Pavement Computer Aided Structural Engineering

PCC—Portland Cement Concrete

PCI—Pavement Condition Index

PCN—Pavement Classification Number

PM—Program Manager or Preventative Maintenance

PMP—Pavement Management Plan

PoF—Probability of Failure

PPD—Physical Property Data

RDS—Records Disposition Schedule

RPAD—Real Property Asset Database Real Property Site Unique Identifier

RPO—Real Property Officer

RPSUID—Real Property Site Unique Identifier

RPUID—Real Property Unique Identifier

SDDC—Surface Deployment and Distribution Command

SIR—Savings to Investment Ratio

SMS—Sustainment Management System

TNAP—Transportation and Airfield Pavements

TRIRIGA—facility management software used by DOD, government, and private industry

UFC—Unified Facilities Criteria

U.S—**.** —United States

USACE—U.S. Army Corps of Engineers

USC—United States Code

Attachment 2

LOCALIZED MAINTENANCE ACTIONS FOR AC AIRFIELD PAVEMENT

Table A2.1. Localized Maintenance Actions for AC Airfield Pavement.

Distress	Description	Distress Severity	Recommended PM	Work Unit
41	ALLIGATOR CR	High	Patching - AC Deep	SqFt
41	ALLIGATOR CR	Medium	Patching - AC Deep	SqFt
41	ALLIGATOR CR	Low	Surface Crack Seal	SqFt
42	BLEEDING	N/A	Do Nothing	
43	BLOCK CR	High	Patching - AC Shallow	SqFt
43	BLOCK CR	Medium	Crack Sealing - AC	Ft
43	BLOCK CR	Low	Do Nothing	
44	CORRUGATION	High	Patching - AC Shallow	SqFt
44	CORRUGATION	Medium	Grinding/Milling	SqFt
44	CORRUGATION	Low	Do Nothing	
45	DEPRESSION	High	Patching - AC Deep	SqFt
45	DEPRESSION	Medium	Patching - AC Deep	SqFt
45	DEPRESSION	Low	Do Nothing	SqFt
46	JET BLAST	N/A	Do Nothing	
47	JT REF. CR	High	Crack Sealing - AC	Ft
47	JT REF. CR	Medium	Crack Sealing - AC	Ft
47	JT REF. CR	Low	Do Nothing	
48	L & T CR	High	Crack Sealing - AC	Ft
48	L & T CR	Medium	Crack Sealing - AC	Ft
48	L & T CR	Low	Do Nothing	
49	OIL SPILLAGE	N/A	Patching - AC Shallow	SqFt
50	PATCHING	High	Patching - AC Deep	SqFt
50	PATCHING	Medium	Patching - AC Deep	SqFt
50	PATCHING	Low	Do Nothing	
51	POLISHED AGG	N/A	Do Nothing	
52	RAVELING	High	Patching - AC Shallow	SqFt
52	RAVELING	Medium	Do Nothing	
53	RUTTING	High	Patching - AC Deep	SqFt
53	RUTTING	Medium	Patching - AC Deep	SqFt
53	RUTTING	Low	Do Nothing	
54	SHOVING	High	Patching - AC Deep	SqFt
54	SHOVING	Medium	Grinding/Milling	SqFt
54	SHOVING	Low	Do Nothing	
55	SLIPPAGE CR	N/A	Patching - AC Shallow	SqFt
56	SWELLING	High	Patching - AC Deep	SqFt
56	SWELLING	Medium	Patching - AC Deep	SqFt
56	SWELLING	Low	Do Nothing	
57	Weathering	High	Patching-AC Shallow	SqFt
57	Weathering	Medium	Do Nothing	
57	Weathering	Low	Do Nothing	
Note: Patching - AC Shallow refers to replacing deteriorated area of pavement surface				
Patching - AC Deep refers to replacing deteriorated area of surface, base, subbase(s)				

Table A2.2. Localized Maintenance Actions for PCC Airfield Pavements.

Distress	Description	Distress Severity	Recommended PM	Work Unit
61	BLOW-UP	High	Slab Replacement	SqFt
61	BLOW-UP	Medium	Patching - PCC Full Depth	SqFt
61	BLOW-UP	Low	Patching - PCC Partial Depth	SqFt
62	CORNER BREAK	High	Patching - PCC Full Depth	SqFt
62	CORNER BREAK	Medium	Patching - PCC Full Depth	SqFt
62	CORNER BREAK	Low	Crack Sealing - PCC	LF
63	LINEAR CR	High	Patching - PCC Partial Depth	SqFt
63	LINEAR CR	Medium	Crack Sealing - PCC	Ft
63	LINEAR CR	Low	Do Nothing	
64	DURABIL. CR	High	Slab Replacement	SqFt
64	DURABIL. CR	Medium	Patching - PCC Full Depth	SqFt
64	DURABIL. CR	Low	Do Nothing	
65	JT SEAL DMG	High	Replace Joint Seal	Ft
65	JT SEAL DMG	Medium	Replace Joint Seal	Ft
65	JT SEAL DMG	Low	Do Nothing	
66	SMALL PATCH	High	Patching - PCC Partial Depth	SqFt
66	SMALL PATCH	Medium	Patching - PCC Partial Depth	SqFt
66	SMALL PATCH	Low	Do Nothing	
67	LARGE PATCH	High	Patching - PCC Full Depth	SqFt
67	LARGE PATCH	Medium	Patching - PCC Partial Depth	SqFt
67	LARGE PATCH	Low	Do Nothing	
68	POPOUTS	N/A	Do Nothing	
69	PUMPING	N/A	Underseal and Replace Joint Seal	Ft
70	SCALING	High	Slab Replacement - PCC	SqFt
70	SCALING	Medium	Patching - PCC Partial Depth	SqFt
70	SCALING	Low	Do Nothing	
71	FAULTING	High	Grinding	SqFt
71	FAULTING	Medium	Grinding	SqFt
71	FAULTING	Low	Do Nothing	
72	SHAT. SLAB	High	Slab Replacement - PCC	SqFt
72	SHAT. SLAB	Medium	Slab Replacement - PCC	SqFt
72	SHAT. SLAB	Low	Crack Sealing - PCC	Ft
73	SHRINKAGE CR	N/A	Do Nothing	
74	JOINT SPALL	High	Patching - PCC Partial Depth	SqFt
74	JOINT SPALL	Medium	Patching - PCC Partial Depth	SqFt
74	JOINT SPALL	Low	Crack Sealing - PCC	Ft
75	CORNER SPALL	High	Patching - PCC Partial Depth	SqFt
75	CORNER SPALL	Medium	Patching - PCC Partial Depth	SqFt
75	CORNER SPALL	Low	Crack Sealing - PCC	Ft
76	ASR	High	Slab Replacement - PCC	SqFt
76	ASR	Medium	Patching - PCC Partial Depth	SqFt
76	ASR	Low	Do Nothing	

Table A2.3. Localized Maintenance Actions for Flexible Road and Parking Pavements.

Distress	Description	Distress Severity	Recommended PM	Work Unit
1	ALLIGATOR CR	High	Patching - AC Deep	SqFt
1	ALLIGATOR CR	Medium	Patching - AC Deep	SqFt
1	ALLIGATOR CR	Low	Surface Crack Seal	SqFt
2	BLEEDING	High	Patching – AC Shallow	SqFt
2	BLEEDING	Medium	Sand, Roll	SqFt
2	BLEEDING	Low	Do Nothing	
3	BLOCK CR	High	Patching - AC Shallow	SqFt
3	BLOCK CR	Medium	Crack Sealing - AC	Ft
3	BLOCK CR	Low	Do Nothing	
4	BUMPS AND SAGS	High	Patching-AC Shallow	SqFt
4	BUMPS AND SAGS	Medium	Grinding	SqFt
4	BUMPS AND SAGS	Low	Do Nothing	
5	CORRUGATION	High	Patching - AC Shallow	SqFt
5	CORRUGATION	Medium	Grinding	SqFt
5	CORRUGATION	Low	Do Nothing	
6	DEPRESSION	High	Patching - AC Deep	SqFt
6	DEPRESSION	Medium	Patching - AC Deep	SqFt
6	DEPRESSION	Low	Do Nothing	
7	EDGE CRACKING	High	Patching-AC Deep	SqFt
7	EDGE CRACKING	Medium	Crack Seal	Ft
7	EDGE CRACKING	Low	Crack Seal	Ft
8	JT REF. CR	High	Patching-AC	SqFt
8	JT REF. CR	Medium	Crack Sealing - AC	Ft
8	JT REF. CR	Low	Do Nothing	
9	LANE/SHOULDER DROP	High	Add Material/Regrade	SqFt
9	LANE/SHOULDER DROP	Medium	Add Material/Regrade	SqFt
9	LANE/SHOULDER DROP	Low	Do Nothing	
10	L & T CR	High	Patching-AC Shallow	SqFt
10	L & T CR	Medium	Crack Sealing - AC	Ft
10	L & T CR	Low	Do Nothing	
11	PATCHING & UTILITY	High	Patching - AC Deep	SqFt
11	PATCHING & UTILITY	Medium	Do Nothing	
11	PATCHING & UTILITY	Low	Do Nothing	
12	POLISHED AGG	N/A	Do Nothing	
13	POTHOLES	High	Patching-AC Deep	SqFt
13	POTHOLES	Medium	Patching-AC Deep	SqFt
13	POTHOLES	Low	Do Nothing	
14	RAILROAD CROSSING	High	Patching-AC Deep	SqFt
14	RAILROAD CROSSING	Medium	Patching-AC Shallow	SqFt
14	RAILROAD CROSSING	Low	Do Nothing	
15	RUTTING	High	Patching-AC Deep	SqFt

Distress	Description	Distress Severity	Recommended PM	Work Unit
15	RUTTING	Medium	Patching-AC Deep	SqFt
15	RUTTING	Low	Do Nothing	
16	SHOVING	High	Patching-AC Deep	SqFt
16	SHOVING	Medium	Grinding	SqFt
16	SHOVING	Low	Do Nothing	
17	SLIPPAGE CRACKING	High	Patching-AC Shallow	SqFt
17	SLIPPAGE CRACKING	Medium	Patching – AC Shallow	SqFt
17	SLIPPAGE CRACKING	Low	Do Nothing	
18	SWELL	High	Patching-AC Shallow	SqFt
18	SWELL	Medium	Grinding	SqFt
18	SWELL	Low	Do Nothing	
19	RAVELING	High	Patching – AC Shallow	SqFt
19	RAVELING	Medium	Surface Seal	SqFt
20	WEATHERING	High	Patching-AC Shallow	SqFt
20	WEATHERING	Medium	Surface Seal	SqFt
20	WEATHERING	Low	Do Nothing	
Note: Patching - AC Shallow refers to replacing deteriorated area of pavement surface				
Patching - AC Deep refers to replacing deteriorated area of surface, base, subbase(s)				

Table A2.4. Localized Maintenance Actions for PCC Road and Parking Pavements.

Distress	Description	Distress Severity	Recommended PM	Work Unit
21	BLOWUP / BUCKLING	High	Slab Replacement	SqFt
21	BLOWUP/ BUCKLING	Medium	Patching - PCC Full Depth	SqFt
21	BLOWUP /BUCKLING	Low	Patching - PCC Partial Depth	SqFt
22	CORNER BREAK	High	Patching - PCC Full Depth	SqFt
22	CORNER BREAK	Medium	Patching - PCC Full Depth	SqFt
22	CORNER BREAK	Low	Crack Sealing - PCC	Ft
23	DIVIDED SLAB	High	Slab replacement	SqFt
23	DIVIDED SLAB	Medium	Crack Sealing, Crack Repair	Ft
23	DIVIDED SLAB	Low	Crack Sealing	Ft
24	DURABILITY CRACK	High	Full depth Patch/Slab Replacement	SqFt
24	DURABILITY CRACK	Medium	Partial Depth Patch	SqFt
24	DURABILITY CRACK	Low	Seal Surface	SqFt
25	FAULTING	High	Patching-PCC Full Depth	SqFt
25	FAULTING	Medium	Grinding*	SqFt
25	FAULTING	Low	Do Nothing	
26	JOINT SEAL	High	Reseal	Ft
26	JOINT SEAL	Medium	Reseal	Ft
26	JOINT SEAL	Low	Do Nothing	Ft
27	LANE/SHLDER DROP-OFF	High	Add Gravel, Shape	SqFt
27	LANE/SHLDER DROP-OFF	Medium	Add Gravel, Shape	SqFt
27	LANE/SHLDER DROP-OFF	Low	Regrade	SqFt
28	LINEAR CR	High	Patching - PCC Partial Depth	SqFt
28	LINEAR CR	Medium	Crack Sealing - PCC	Ft
28	LINEAR CR	Low	Do Nothing	
29	PATCHING (LARGE)	High	Patch Replacement	SqFt
29	PATCHING (LARGE)	Medium	Crack Seal	Ft
29	PATCHING (LARGE)	Low	Do Nothing	
30	PATCHING (SMALL)	High	Patch Replacement	SqFt
30	PATCHING (SMALL)	Medium	Crack Seal	Ft
30	PATCHING (SMALL)	Low	Do Nothing	
31	POLISHED AGGREGATE	NA	Do Nothing	
32	POPOUTS	NA	Do Nothing	
33	PUMPING	NA	Underseal	SqFt

Distress	Description	Distress Severity	Recommended PM	Work Unit
34	PUNCHOUT	High	Slab Replacement	SqFt
34	PUNCHOUT	Medium	Full Depth Patch	SqFt
34	PUNCHOUT	Low	Seal Cracks	Ft
35	RAILROAD CROSSING	High	Large Patch	SqFt
35	RAILROAD CROSSING	Medium	Grinding	SqFt
35	RAILROAD CROSSING	Low	Do Nothing	
36	SCALING	High	Partial Depth Patch	SqFt
36	SCALING	Medium	Do Nothing	
36	SCALING	Low	Do Nothing	
37	SHRINKAGE CRACKS	NA	Do Nothing	
38	SPALLING, CORNER	High	Partial Depth Patch	SqFt
38	SPALLING, CORNER	Medium	Partial Depth Patch	SqFt
38	SPALLING, CORNER	Low	Crack Seal	Ft
39	SPALLING, JOINT	High	Partial Depth Patch	SqFt
39	SPALLING, JOINT	Medium	Partial Depth Patch	SqFt
39	SPALLING, JOINT	Low	Crack Seal	Ft

Table A2.5. Localized Maintenance Actions for Unsurfaced Pavements.

Distress	Description	Distress Severity	Recommended PM	Work Unit
81	Improper Cross Section	High	Add material, grade, compact	SqFt
81	Improper Cross Section	Medium	Grade only	SqFt
82	Improper Drainage	High	Reshape, construct, compact or flare out ditch	SqFt
82	Improper Drainage	Medium	Clean out ditches	SqFt
83	Corrugations	High	Add material, grade, compact	SqFt
83	Corrugations	Medium	Grade only	SqFt
84	Dust	High	Add material, grade, compact	SqFt
84	Dust	Medium	Add stabilizer	SqFt
85	Potholes	High	Add material, grade, compact	SqFt
85	Potholes	Medium	Add material, grade, compact	SqFt
86	Ruts	High	Add material, grade, compact	SqFt
86	Ruts	Medium	Add material, grade, compact	SqFt
87	Loose Aggregate	High	Add material, grade, compact	SqFt
87	Loose Aggregate	Medium	Grade, compact	SqFt