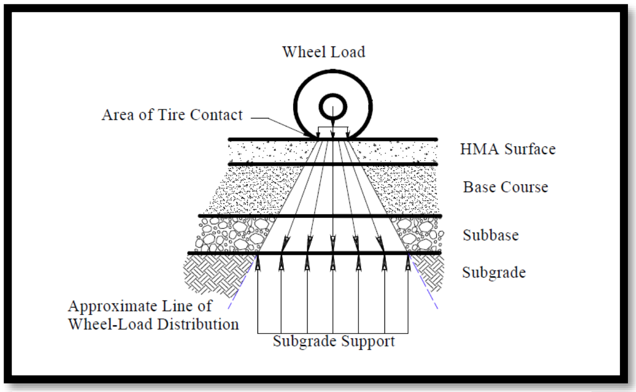
# Appendix G Airfield Pavements

## Introduction

Pavement is one of the most important aspects of an airport. If an airport has failing pavement (runway, taxiway, or apron), aircraft operations will suffer and can affect aircraft safety. When considering pavement design, construction, and maintenance, certain elements need to be considered in order to develop pavement surfaces. Some of these elements include but are not limited to the design aircraft that serves the airport, economic factors, weather conditions, the location of the airport, and personal preference of the owner/operator. This section highlights general knowledge of airfield pavements and things to consider when viewing the pavement at your airport.

## Pavement Types

There are two main types of pavement on an airfield. These are Hot-Mix Asphalt (HMA) and Portland Cement Concrete (PCC). HMA is the only type of airfield pavement at Black Hills Airport – Clyde Ice Field. HMA is a flexible-type of pavement, and distributes aircraft weight through the layers below the asphalt surface (See exhibit). When constructed, the HMA surface is in a smooth state. This is a result of the application method of rolling the surface for proper compaction.




*Source: Advisory Circular 150/5380-6b*

HMA has FAA specifications and design criteria and is typically referred to as "P-401". P-401 is an FAA specifications that contains requirements for the materials used in the pavement such as aggregate, bituminous material, or any admixtures. These specifications also contain requirements for construction, quality control, and quality assurance. For further detail, refer to FAA Advisory Circular 150/5370-10G, *Standards for Specifying Construction of Airports*.

## Surface Texturing/Measuring

Because HMA initially has a smooth surface when constructed, it is important to look at methods that increase the friction of the surface. This can be completed by grooving. Grooving tends to be the most common type of surface treatment, and is typically constructed by cutting transverse grooves, 1 ½ inches apart, and ¼ inch deep the entire length of the runway after the pavement has set. These saw cut grooves help with water runoff and reduce the risk of aircraft hydroplaning.

Other methods to increase surface friction for HMA consist of Porous Friction Course (PFC), Chip Seals, and Aggregate Slurry Seals. The ultimate goal in this process is to give the aircraft greater friction and better maneuverability during adverse weather conditions.

At commercial service airports, it is a requirement to monitor the level of friction provided by pavements during adverse weather conditions. This can be completed by operations personnel on the field monitoring the braking action of various surfaces with friction measurement equipment. At an airport serving general aviation aircraft only, pavement friction is not required to be monitored by friction measuring equipment during adverse weather conditions. This pavement is monitored by operations personnel and presented with values of braking action reported as good, fair, poor, or nil.

# Pavement Strength

Pavement strength is driven by multiple factors. Initially, the airport needs to determine the design aircraft that will be using the airport. The design aircraft can be determined by one single-most demanding aircraft, or a mix of the most demanding aircraft that drive similar standards. By identifying the design aircraft, the airport can determine the pavement strength needed for the pavement surfaces on the airfield. See Appendix H Airfield Design for more information on the design aircraft.

After determining the design aircraft, the FAA has identified a standard method to report pavement strength at an airport. In the aviation world, there are two types of pavement strength classification; Utility and Other-Than-Utility. Utility pavements are capable of handling aircraft of up to 12,500 pounds maximum gross weight, while Other-Than-Utility pavements are capable of handling aircraft greater than 12,500 pounds.

If the design aircraft is 12,500 pounds or less, the pavement strength reporting remains fairly simple and straight forward. However, if the design aircraft is determined to have a maximum gross weight of greater than 12,500 pounds, the ACN-PCN[1] method is used to determine what the pavement is capable of supporting. ACN is the number that expresses the relative effect of an aircraft at a given configuration on a pavement structure for a specified subgrade strength, while PCN is a number that expresses the load-carrying capacity of a pavement for unrestricted operations. The ACN-PCN method of determining pavement strength does have some drawbacks. It is only intended to report relative pavement strength (so airport operators can evaluate acceptable operations of aircraft), but it is not intended for pavement design or pavement evaluation.

[1] A method of reporting pavement strength initiated by the International Civil Aviation Organization (ICAO) and adopted by the U.S. The instructions for determining the ACN/PCN are in FAA Advisory Circular 150/5335-5C *Standardized Method of Reporting Airport Pavement Strength*.

| PCN Reporting Format | | | | | | |
|---|---|---|---|---|---|---|
| | Pavement Type | Subgrade Strength | | | Tire Pressure (psi) | Method of Determination |
| | | | Flexible (CBR) | Rigid (k-value) | | |
| Numerical Value | R - Rigid | A - High | ≥ 13 | ≥ 442 | W - no limit | T - Technical Study |
| | | B - Medium | >8 & < 13 | > 221 & < 442 | X - 182-254 | |
| | F - Flexible | C - Low | >4 & ≤ 8 | >92 & ≤ 221 | Y - 74-181 | U - Using Aircraft |
| | | D - Ultralow | ≤ 4 | ≤ 92 | Z - 0-73 | |
| Expressed as follows: | | | | | | |
| ### | / R or F | / A, B, C or D | | / W, X, Y or Z | / T or U | |

| PCN for Black Hills Airport - Clyde Ice Field | |
|---|---|
| | Runway 13/31 |
| Pavement Classification Number (PCN) | 13/F/D/X/T[2] |

# Markings

Pavement marking is an important aspect of pavement development. Not only does it give the pilot vital information on where they are located on the airfield, but it also can affect the surface friction of the pavement.

More specifically for runway markings, there are two types of paint applications; striated or solid. Striated markings are stripe-like patterns, while solid runway pavement markings do not have any spacing. Pavement heats quicker than paint and, as a result, any exposed pavement will melt any frozen contaminants quicker than what is on a painted surface. By striating the pavement, gaps of exposed pavement can help melt frozen contaminants quicker than if the pavement marking was solid. This increases friction and helps aircraft stop more consistently along the runway. As a result, striated pavement markings are more relevant in northern-climates, where weather contaminants can accumulate and freeze on runway surfaces. Furthermore, striated markings are only used for runway markings, as aircraft are operating at a higher speed. Additional details regarding pavement marking requirements can be found under *Appendix K – Navigational Aids*.

[2] The calculations are based on annual departures by a mixture of aircraft including: Single Wheel (SW) 2,000 lbs (3350 departures), SW 5,000 lbs (2250 departures), SW 10,000 lbs (3200 departures), SW 15,000 lbs (300 departures) and Dual Wheel 15,000 lbs (100 departures).

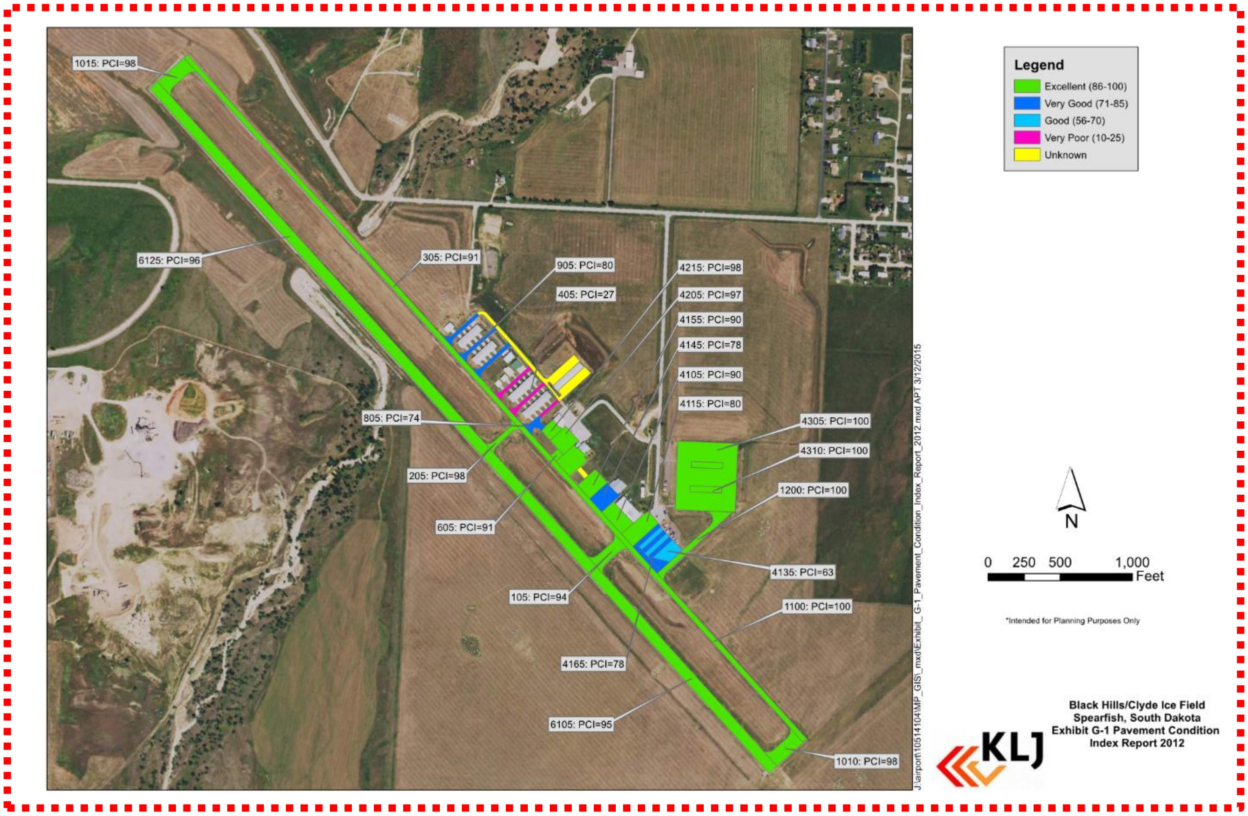
# Maintenance

Maintenance is necessary throughout the useful life of the pavement. Moreover, per FAA Grant Assurance #11, federally-funded airports are required to implement a Pavement Preventative Maintenance program. This program assures an effective airport pavement maintenance-management program that will be used throughout the useful life of any pavement constructed, reconstructed, or repaired with federal funds. Pavement distress may include cracking, joint seal damage, disintegration, distortion, or loss of skid resistance. All of these distresses affect the aircraft's ability to maneuver around the airport safely. Moreover, these distresses can cause FOD (Foreign Object Debris) to accumulate on the pavement surface which can damage aircraft and compromise safety.

Pavement maintenance can either be contracted out, or serviced by operations/maintenance personnel on the airfield. Some pavement maintenance methodologies include, but are not limited to, patching, crack seals, mill and overlays, rejuvenators, spall-repairs, or slurry seals. Sometimes fabrics are added to HMA pavements, either during initial construction or as a pavement maintenance method (sometimes called pre-pave fabric), and add resistance to typical HMA pavement wear. Typical repair methods for flexible pavement (HMA) can include any of the above, but rigid pavement (PCC) typically is repaired by crack sealing. In the event that pavement has failed or reached the end of its useful life, a complete reconstruction is necessary.

To monitor the distress of pavement at airports, Pavement Condition Index (PCI) Reports are completed periodically. These reports can sometimes be completed on a state-wide basis, and are typically updated every three years. PCI reports tell the airport owner how distressed their pavement is based on a percentage value from 100 to 0. With this information, airport owners can plan for the financial needs of pavement management accordingly. **Exhibit G-1** is the most current PCI report for the Black Hills Airport – Clyde Ice Field (SPF).

## Exhibit G-1 Pavement Condition Index Report 2012

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# Black Hills Airport - Clyde Ice Field Pavement Data

## Table G-1 Runway Pavement 13-31

| Runway Pavement for 13-31 at Black Hills Airport - Clyde Ice Field | | | |
|---|---|---|---|
| Criteria | Runway 13-31 | | |
| | Existing | Future | Ultimate |
| Length | 6,400’ | 6,400’ | 6,400’ |
| Width | 75’ | 75’ | 100’ |
| Type | Asphalt | Asphalt | Asphalt |
| Strength | 33,000 (SW) 45,000 (DW) | 33,000 (SW) 45,000 (DW) | 33,000 (SW) 45,000 (DW) |
| PCI Value | 95.3 | 95 | 95 |
| RDC | B-II | B-II | C-II |

*Source: South Dakota Department of Transportation - Office of Aeronautics; KLJ Analysis*

## Table G-2 Runway Pavement 05-23

| Runway Pavement for 05-23 at Black Hills Airport - Clyde Ice Field | | | |
|---|---|---|---|
| Criteria | Runway 05-23 | | |
| | Existing | Future | Ultimate |
| Length | Na | 3,550’ | 3,880’ |
| Width | Na | 60’ | 60’ |
| Type | Na | Asphalt | Asphalt |
| Strength | Na | 12,500 DW | 12,500 DW |
| PCI Value | Na | 95 | 95 |
| RDC | Na | A/B-I Small | A/B-I Small |

*Source: South Dakota Department of Transportation - Office of Aeronautics; KLJ Analysis*

Construction Details

RWY 13-31 – (approximately 1900 lineal feet of the north end) is six inches of P-401 bituminous pavement, eleven inches of P-209 aggregate base and twelve inches of P-152 scarified and recompacted subgrade. The remaining 4500 lineal feet – three and one-half inches P-401 bituminous overlay (2008) over six inches of unknown bituminous pavement and approximately thirty-six inches of unknown subbase material.

Existing Issues

RWY 13-31 – the north (approximately 1900 lineal feet) end is in good condition. The remaining 4500 lineal feet contains some normal transverse cracking. Pavement markings are in poor conditions – basically not visible as of December 2014.

## Table G-3 Taxiway Pavement - Twy A

| Taxiway Pavement for Twy A at Black Hills Airport - Clyde Ice Field | | | |
|---|---|---|---|
| Criteria | Taxiway A | | |
| | Existing | Future | Ultimate |
| Width | 35’ | 35’ | 35’ |
| Type | Asphalt | Asphalt | Asphalt |
| Strength | 33,000 (SW) 45,000 (DW) | 33,000 (SW) 45,000 (DW) | 33,000 (SW) 45,000 (DW) |
| PCI Value | 95.3 (91 to 100) | 90 | 90 |

*Source: South Dakota Department of Transportation - Office of Aeronautics; KLJ Analysis*

## Table G-4 Taxilane Pavement - Hangar Areas

| Taxilane Pavement for Hangar Areas at Black Hills Airport - Clyde Ice Field | | | |
|---|---|---|---|
| Criteria | Taxilanes | | |
| | Existing | Future | Ultimate |
| Width | 25’ | 25’ to 35’ | 25’ to 35’ |
| Type | Asphalt | Asphalt | Asphalt |
| Strength | 12,500 (SW) | 12,500 (SW) | 12,500 (SW) |
| PCI Value | 64.0 (27 to 80) | 75 | 75 |

*Source: South Dakota Department of Transportation - Office of Aeronautics; KLJ Analysis*

Construction Details

Taxiway A – is constructed with six inches of P-401 bituminous pavement, eleven inches of P-208 aggregate base and twelve inches of P-152 scarified and recompacted subgrade.

Existing Issues

Taxiway A has no significant issues. The north two taxilanes are generally in good condition with some normal cracking. The remaining taxilanes are poor with numerous areas of alligatored pavement failure.

## Table G-5 Apron Pavement

| Apron Pavement for Mid-Field Area at Black Hills Airport - Clyde Ice Field | | | |
|---|---|---|---|
| Criteria | Main Apron (started from New Apron East of Entry Road) | | |
| | Existing | Future | Ultimate |
| Dimensions | 22,100 sy | 40,300 sy (with taxilanes and self-fueling island) | 65,500 sy (with taxilanes and self-fueling island) |
| Type | Asphalt with Concrete hardstands | Asphalt with Concrete | Asphalt with Concrete |
| Strength | 33,000 (SW) 45,000 (DW) | 33,000 (SW) 45,000 (DW) | 33,000 (SW) 45,000 (DW) |
| # Tiedowns | 15-19 | 20-24 | 40-46 |
| PCI Value | 100 | 75 minimum | 75 minimum |
| | West Apron (Original area parallel to Runway 13-31) | | |
| | Existing | Future | Ultimate |
| Dimensions | 15,000 sy | 2,000 sy | 2,000 sy |
| Type | Asphalt | Asphalt | Asphalt |
| Strength | 12,500 (SW) | 12,500 (SW) | 12,500 (SW) |
| # Tiedowns | 17 | | |
| PCI Value | 85.2 (63 to 98) | 75 minimum | 75 minimum |

*Source: South Dakota Department of Transportation - Office of Aeronautics; KLJ Analysis*

Construction Details

The new apron is six inches of P-401 bituminous pavement, eleven inches of P-208 aggregate base and twelve inches of P-152 scarified and recompacted subgrade. The two concrete hardstands are eight inches of P-501 portland cement concrete, nine inches of P-208 aggregate base and twelve inches of P-152 scarified and recompacted subgrade.

The old apron is approximately five inches of bituminous pavement with an unknown depth of base course material.

Existing Issues

The main apron has no significant issues. The west apron is generally fair to poor condition with numerous cracks and areas of pavement failure.