ACRP 07-09
APRON PLANNING AND DESIGN GUIDEBOOK

FINAL REPORT

Prepared for
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TRANSPORTATION RESEARCH BOARD

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

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ABSTRACT

This research supported the development of a Guidebook that provides best practices for planning and designing apron areas for all sizes of airports in the United States. The Guidebook is intended to be used by airport operators, airlines, and design consultants. There exists no single document providing consistent guidance on apron planning and designing. This has resulted in apron layouts and markings that not only vary from airport to airport, but within airports. As a result, a comprehensive guidebook is needed to address the best practices to apron planning and design that support enhanced operational efficiency and safety.

This Guidebook provides guidance on the apron planning or design process, developing an understanding of the apron environment, and incorporating detailed guidance on planning considerations and design implications. Given the number of sources that provide guidance on various aspects of apron planning and design, relevant sources of information are provided to provide the reader with easily identifiable references to more detailed information relating to specific topics.

CHAPTER 1 BACKGROUND

This Final Report is intended to provide background to the research conducted in support of development of the ACRP Project 07-09, Apron Planning and Design Guidebook. This report is organized into four chapters and three appendices, as follows:

- Chapter 1 – Background
- Chapter 2 – Research Approach
- Chapter 3 – Findings and Applications
- Chapter 4 – Conclusions and Recommendations
- Appendix A – Literature Search
- Appendix B – Evaluation of Literature
- Appendix C – Apron Observations

PROBLEM LEADING TO THE STUDY

Aircraft apron areas must provide safe and economical facilities while maintaining flexibility to accommodate reasonably anticipated changes in a dynamic industry. Aprons are some of the most active and, at times, congested areas at an airport. Aircraft taxi to and from aprons, while ground service equipment (GSE) used for aircraft servicing, fueling, deicing, and cargo and baggage loading and unloading services operate in close proximity. Additionally, there is a potential for aircraft congestion and interactions, particularly at active airports during periods of concentrated aircraft activity. In addition to the dynamic aspects of the apron environment, facilities and equipment also influence apron planning and design, particularly where the facility geometry/footprint is unique or constrained and at facilities with significant apron equipment (passenger loading bridges, hydrant fuel pits, and related items).

All apron areas (e.g., terminal area, cargo, general aviation, deicing pads, remote hardstands) must be sufficiently delineated to protect the safety of aircraft occupying these areas and to allow personnel to safely and efficiently move to, from, and between the aircraft to service them between operations. Aircraft servicing generally requires the movement of ground service vehicles in close proximity to parked and moving aircraft, making it critical that vehicular access be incorporated into apron planning. In addition, aprons must provide an area for aircraft maneuvering without significantly affecting adjacent parked aircraft or aircraft taxiing through or near apron areas. To accommodate the efficient movement of aircraft, planners and designers often incorporate pushback areas or locate and orient aprons in a way that allows aircraft to enter and exit the aprons quickly.

In the terminal area, apron planning considerations are based on the role of the airport in the commercial aviation system and the size of aircraft reasonably expected to operate at the airport in the near term and in the longer-term. The gate area and associated terminal interface must provide a safe, orderly, and efficient environment for transferring passengers, baggage, and small cargo, as well as servicing aircraft for subsequent operations. Passengers and baggage are transferred between the parked aircraft and the terminal building, while small cargo may be transferred between the parked aircraft and the terminal building or another location/facility on the airfield. Clear definition of specific areas of the apron (for aircraft parking, GSE staging, aircraft taxiing, aircraft pushbacks, vehicle service roads, and other specific functions) is critical to maximizing the safety and efficiency of the transfer operations.

Technical requirements for aprons include the application of industry standards for layout, marking, and lighting; access for emergency vehicles; and fixed or mobile services for aircraft servicing. Evolving trends in aircraft types and characteristics, such as regional jets and new large aircraft (Federal Aviation Administration [FAA] Airplane Design Group VI), and related requirements should be evaluated in addition to new technologies for aircraft handling and servicing.

Several existing sources provide standards for apron planning; however, these standards typically provide guidance for only one type of apron facility or one design/operational aspect. A guidebook that summarizes best practices for apron planning and design would assist planners, designers, airport operators, and others in enhancing the operational efficiency and safety of aprons by standardizing layouts and markings for a wide variety of airports and apron facilities. Additionally, the best practices guidebook would provide information to enable planners/designers to incorporate flexibility in apron facilities to accommodate the likelihood of change over the planning horizon.

OBJECTIVES AND SCOPE OF THE RESEARCH PROJECT

The objective of this research is to develop a guidebook that provides best practices for planning, designing, and marking apron areas for all sizes of airports in the United States. The guidebook is intended to allow airport operators, airlines, design consultants, and others to better understand the apron environment and operations in order to provide the necessary background information and best practices for apron planning and design. This guidebook covers a variety of aprons including terminal, general aviation, cargo, deicing, helipads, and remote aprons.

As outlined by ACRP, the research team was directed to develop a guidebook covering the following apron planning, design, and operational considerations:

- Facility geometrics (exploring relationship between aeronautical surfaces (e.g.,14 CFR Part 77), buildings, aprons and apron access points)
- Markings (i.e., lead-in and lead-out lines, aircraft safety envelope, GSE safety boxes)
- Lighting
- Aircraft design groups that include retrofit, nextgen, and existing aircraft
- Taxiways, taxilanes, and vehicle service roads
- Engine start-up positions/Power versus tow/Jet blast/Noise
- Ground Service Equipment (GSE) operations /fueling
- Snow removal operations

Additional planning, design, and operational considerations where included during the study:

- Stakeholder and agency involvement
- Passenger enplaning and deplaning
- Vehicle roadways
- Airline operations
- Control towers
- Signage
- Technology/planning tools
- Navigational aids
- Relate regulations and guidance

- Design considerations

The scope of this research project included development of a Guidebook to provide best practices for apron planning and design. The Guidebook covers the following topics:

- Explanation of the apron and planning design process;
- Understanding the apron environment;
- Best practices for planning and design of aprons.

CHAPTER 2 RESEARCH APPROACH

Figure 1 below illustrates the research approach to complete to this project. The scope of the research for creating the guidebook included a review and evaluation of existing literature to provide a foundational understanding of existing regulatory guidance, applicable research, industry information, and practices at airports within the United States. The output was used during subsequent tasks in evaluating and categorizing apron planning guidance, identifying opportunities to enhance apron planning and design guidance, and preparing for planned observations to document apron operating environments and operational influences on apron layouts.

In order to better understand the apron operating environment, site visits were conducted to airports that provided the types of apron facilities of interest in this research project (terminal apron, deicing aprons, general aviation aprons, etc.). These site visits provided a greater understanding of the operational and physical influences on apron configurations. Of particular interest were the operational changes or adjustments made by apron users at facilities where physical, dimensional, and/or operational constraints require compromise.

Upon completion of the site observations, a draft outline for the Guidebook was developed and provided to the project panel for review. Upon confirmation of the Guidebook outline, analysis and research were conducted to prepare a draft of the Guidebook which was then submitted to the project panel for review and comment.

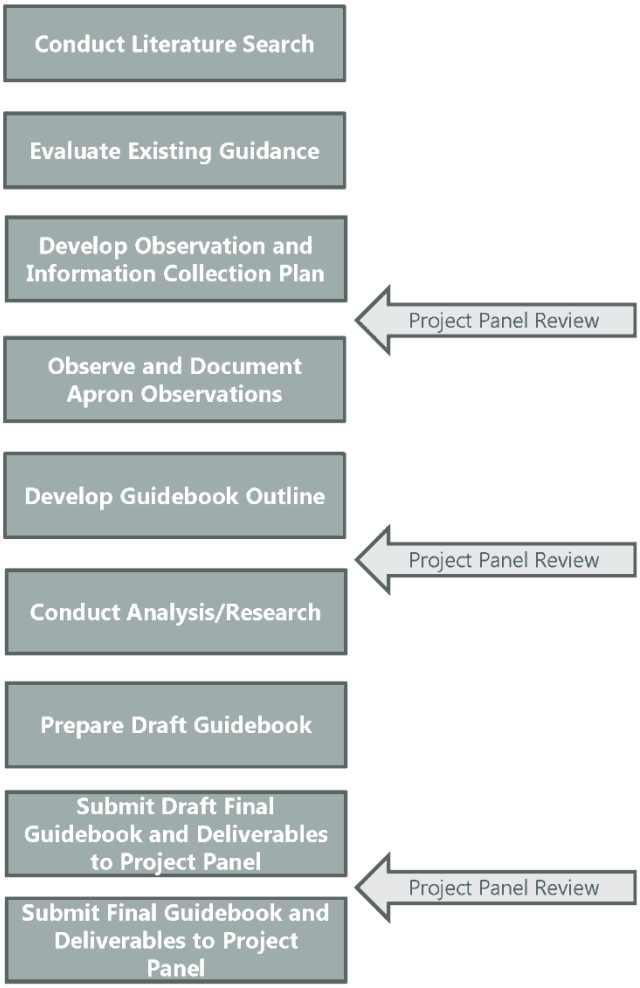

Figure 1 Project Approach
Source: Ricondo & Associates, Inc.

This chapter presents the approach followed in this research project and used to develop the Guidebook:

- Literature Search
- Evaluation of Existing Guidance
- Apron Observations
- Development of Guidebook Outline
- Conduct Analysis/Research
- Preparation of the Guidebook

LITERATURE SEARCH

An extensive literature search of existing regulatory guidance, applicable research, industry information, and practices at airports within the United States was completed. The goal of this literature search was to provide a foundational understanding of existing regulatory guidance, applicable research, industry information, and practices at airports within the United States. The output from this task was used during subsequent tasks in evaluating and categorizing apron planning

guidance, identifying opportunities to enhance apron planning and design guidance, and preparing for planned observations to document apron operating environments and operational influences on apron layouts.

The literature search resulted in a collection of materials from various government agencies, academic sources, aviation and airport organizations, airlines, and aircraft and equipment manufacturers. The information was collected using Microsoft SharePoint website with an online database which allowed the team to collaborate by observing other team members entries. The literature search was dynamic and continued throughout the study.

EVALUATION OF EXISTING GUIDANCE

An evaluation of existing guidance was completed to identify overlapping and redundant guidance as well any partially lacking, or gaps in, apron planning guidance. Using the literature search, the existing guidance was compared and correlated to apron planning design topics and identified limitations, enhancements and potential topics within this guidance material to inform the planned site visits. The information was collected using the same Microsoft SharePoint database used for the literature search.

APRON OBSERVATIONS

In order to develop a thorough and comprehensive understanding of the apron operating environment and the ways operational practices and user needs influence the configuration and operation of apron areas, site observations were conducted at several airports with varying types of apron facilities. Of particular interest was the operational changes or adjustments made by apron users at facilities where physical, dimensional, and/or operational constraints required compromise.

The intent of the site visits was to provide a greater understanding of the operational and physical influences on apron configurations and to discuss these with airport operators and users. Of particular interest were operational changes or adjustments made by apron users at facilities where physical, dimensional, and/or operational constraints require compromise.

An observation and information collection plan was developed in advance with a goal of comprehensively exploring the practices used to plan and operate apron facilities, including the strengths and weaknesses of these facilities and their operations, at a variety of airports. The team identified several target airports to observe and collect information on each of the following types of apron area facilities at various locations across the United States.

- Terminal gate areas (large-, medium-, small-, and non-hub airports)
- Deicing facilities
- Cargo facilities
- Maintenance hangars
- Remain overnight/overday aprons
- General aviation facilities
- Helipads

The targeted airports represented geographic, climatic, and operational diversity to ensure that the compilation of data and observations of apron operations were comprehensive. A goal in undertaking the observations was to understand those elements of the existing apron areas that are viewed to perform well in supporting safe and efficient operations/activity and to understand those specific layouts/design aspects that may have been implemented to address unique aspects of the facility

under observation. A second goal was to ensure a comprehensive understanding of the operational aspects that are key to the planning and design of each type of facility.

During the site visits, the research team obtained a contextual understanding of relevant operational, physical, and geographical profiles of each airport. The research team compiled and summarized the information collected by describing apron operations observed at the different facility types. In addition, the summary specified any operational challenges or influences associated with each type of apron facility based what was observed and feedback/input obtained from airport representatives and tenants.

Through these observations, the team obtained an understanding of relevant operational and physical profiles of each airport. Additionally, the observations provided the team with a better understanding of specific layouts, operational procedures, and designs that perform well in supporting safe and efficient operations.

Table 1 identifies the airports where apron site observations were conducted.

Table 1 Apron Observation Sites

Airport	Airport Code	FAA Airports Region	Visit/ Synthesis[1]	Role	Climate	ATC
Baton Rouge Metropolitan Airport (Baton Rouge, LA)	BTR	Southwest	Synthesis	Small Hub	Warm	Towered
Centennial Airport (Centennial, CO)	APA	Northwest Mountain	Visit	Reliever	Cold	Towered
Charles B. Wheeler Downtown Airport (Kansas City, MO)	MKC	Central	Visit	Reliever	Cold	Towered
Denver International Airport (Denver, CO)	DEN	Northwest Mountain	Visit	Large Hub	Cold	Towered
Cleveland Hopkins International Airport	CLE	Great Lakes	Synthesis	Medium Hub	Cold	Towered
Detroit Metropolitan Wayne County Airport	DTW	Great Lakes	Synthesis	Large Hub	Cold	Towered
Downtown Fort Lauderdale Heliport	DT1	Southern	Synthesis	Not Applicable	Warm	Non-Towered
Memphis International Airport / FedEx Hub (Memphis, TN)	MEM	Southern	Synthesis	Medium Hub	Warm	Towered
General Mitchell International Airport (Milwaukee, WI)	MKE	Great Lakes	Synthesis	Medium Hub	Cold	Towered
Ogden-Hinckley Airport (Ogden, UT)	OGD	Northwest Mountain	Visit	Reliever	Cold	Towered
O'Hare International Airport (Chicago, IL)	ORD	Great Lakes	Synthesis	Large Hub	Cold	Towered
San Diego International Airport	SAN	Western-Pacific	Visit	Large Hub	Warm	Towered

Note:

[1] Visit indicates that an observational site visit was conducted at the airport. Synthesis indicates observations were conducted from previous work experiences and discussions with airport staff may have occurred.

Source: Ricondo & Associates, Inc.

DEVELOPMENT OF GUIDEBOOK OUTLINE

The team developed a draft outline for the Guidebook based on the information collected, analyzed, and compiled in initial tasks of the project. The team identified the analytical needs for the Guidebook to provide users with a thorough understanding of the operations/activities that occur on apron facilities and present best practices and standards (where available) to ensure that applicable guidance is available for the planning and design of apron facilities at a variety of airports and specific facilities within airports. The draft outline contained topics that users would find applicable and relevant.

Initially it was envisioned that the Guidebook would be structured with a discrete section for each type of apron facility and common subsections. It was determined that providing guidance for discrete types of aprons would result in redundant information since many aprons may share the same planning guidance (e.g., pavement markings are similar for cargo, terminal, and general aviation aprons). It was determine that the Guidebook would be most beneficial if structured as follows:

- Section 1: Introduction that presents background on the research project and organization of the Guidebook.
- Section 2: Explanation of the apron planning and design process including stakeholder involvement and agency coordination.
- Section 3: Provide an understanding of the apron environment to inform the Guidebook user of the different type of aprons, the activities that occur in and around the apron areas, and the equipment typically used. Since a wide variety of activities occur on aircraft aprons, this section is intended to help the user recognize the uses of the aprons prior to initiating planning and design efforts to ensure proper application of the guidance elements.
- Section 4: Summarize detailed guidance and best practices on various apron planning considerations, design implications, and related regulations/guidance.

A draft of the Guidebook outline was provided to the project panel for review. The outline was reviewed, revised, discussed, and finalized during the project panel interim meeting. Minor revisions (e.g., wording, placement of sections) occurred during drafting of the Guidebook, but the content remained unchanged.

PREPARATION OF THE GUIDEBOOK

Based on the draft outline, the team prepared the Guidebook to provide an understanding of the operations, influences, and activities that occur on the various apron facilities. Analysis and research was conducted to collect any lacking or limited information on apron operations, planning and design guidance uncovered during documentation and internal review. The document was structured using the outline finalized following the interim meeting. The Guidebook contains many images and illustrations to clearly present examples of aprons and associated equipment as well as demonstrates apron planning and design guidance. Given the wide variety of existing sources that guidance and standards for apron planning and design, each section (where applicable) provides a list of sources that can be used to find additional information on the subject.

CHAPTER 3 FINDINGS AND APPLICATIONS

LITERATURE SEARCH

The literature search resulted in a collection of materials from various government agencies, academic sources, aviation and airport organizations, airlines, and aircraft and equipment manufacturers. The literature search resulted in a bibliography which is contained in Appendix A. This bibliography was expanded throughout the course of the study as additional research and analysis was completed.

EVALUATION OF LITERATURE

The literature review summary is presented in a standardized format that summarizes the limitations in the existing guidance that the team identified during the literature review process, the opportunities for potential enhancements to existing guidance as the research effort progresses, and an assessment of whether the guidance material that was reviewed suggested specific information that could be pursued during the site visit process. The literature review summary is presented by topic: Apron Equipment, Design Implications and Considerations, Long-Term Considerations, Operational, Physical, Related Regulations, and Technology/Planning Tools. The evaluation is present in Appendix B.

Based on the evaluation of the guidance materials, the following limitations in the available guidance and candidate areas for enhancement were identified. These areas are considered to be "gaps" in available industry guidance material to support the planning and design of apron facilities. Subsequent research efforts will include but not be limited to the development of relevant guidance to address the gaps.

- Apron Equipment
  - Aircraft docking systems
  - Baggage equipment (including permanent apron equipment such as input belts)
  - Cargo equipment
  - Deicing equipment – general aviation (GA) aircraft
  - Ground power – location and size, GA aircraft
  - Hydrant fueling – GA facilities and heliports
  - Lighting – especially the identification of ideal locations
  - Passenger loading bridges – especially for regional jet (RJ)/turboprop aircraft
  - Preconditioned air – especially for GA aircraft
- Design implications
  - Fueling systems for helipads
- Long-term Considerations
  - Fleet evolution – impacts and accommodation of wingtip devices
  - Flexibility – changing of aircraft fleets at an airport

- Operational
  - Deicing procedures (especially GA aprons and cargo ramps)
  - Ground passenger loading - walkways and standards
  - Security – aprons for aircraft searches and helipad security
  - Snow removal – apron considerations for snow removal, stockpiling, and melting
  - Surface Movement Guidance Control System (SMGCS) – for GA operations
  - Vehicle circulation – layouts near aprons, jet blast fences, helipads
- Physical
  - Aircraft clearances/separations for cargo facilities, maintenance facilities, and helipads
  - Ramp towers – considerations for planning ramp towers, helipad towers
  - Building clearances for cargo aprons, helipads
  - Emergency vehicle access – access for ARFF, medical, police, U.S. CBP/TSA
  - GSE – locations for apron storage
  - Markings – vary between airports and airlines
  - Tie-downs – placement for fleet flexibility
- Related regulations
  - Safety Management System (SMS) programs and applicability to apron planning and design
  - Sustainability considerations related to apron planning and design
- Technology / planning tools
  - None identified at this time

APRON OBSERVATIONS

A summary of the apron site observation is contained within Appendix C. The summaries describe apron operations observed at the different facility types at each airport targeted for observation. In addition, the summaries specify operational challenges and influences associated with each type of apron facility based on observations and feedback/input obtained from airport representatives and tenants. The summaries also contain photographs and aerial images.

CHAPTER 4 CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The primary deliverable of this final report is the Apron Planning and Design Guidebook. As outlined in the Guidebook, the following main conclusions resulted from the research conducted under ACRP 07-09.

- Use of the material in this Guidebook does not relieve the planner or designer of the need to thoroughly understand the operating environment at a specific airport and in the vicinity of a proposed project and to coordinate appropriately with operators on the apron, and other stakeholders when warranted by the specific nature of an individual project. In fact, this Guidebook encourages those approaches to maximize the safety and effectiveness of apron projects, rather than following a rigid set of apron planning and design recommendations that does not recognize the operational and physical differences among airports.
- It is important to recognize that the applicability of this guidance, both in scope and level of detail, will vary based on the nature of specific projects. Projects can range from high level master planning efforts, in which the goal is to ensure that sufficient analysis is performed to provide for long-range needs to be accommodated within an available development envelope, to detailed facility programming and design, in which subsequent project implementation is expected. It is up to the user of this Guidebook to determine the optimal use of, or alignment with, the information presented herein.

RECOMMENDATIONS

The team recognizes that apron planning and design may evolve as a result of governmental regulations/mandates and industry trends. This Guidebook represents the state of the industry practices in effect in the 2012 and 2013. It is the team's recommendation that the content of the Guidebook be updated or revised if there are notable regulatory changes or an evolution of industry planning parameters, which could include closer harmonization with ICAO guidance..

Plan for Implementing the Research Products

Guidebook

This research project included development of a Guidebook to provide information to airport operators, planner, and designers on best practices for apron planning and design. The Guidebook provides (1) an explanation of the apron and planning design process, (2) an understanding the apron environment, and (3) best practices for planning and design of aprons. The Guidebook will be posted on the TRB website, available for download by interested parties.

Presentation

The research team has prepared a presentation summarizing the finding of this research. It is intended to be used by ACRP to inform the aviation community of the Guidebook availability and general content.

Suggested Further Research

There are potential opportunities for additional research into apron planning and design, particularly as it relates to terminal building interface and fleet evolution. These may include:

- Impacts of Safety Management Systems (SMSs) encompassing non-movement and leased areas on apron planning and design.

- Aircraft data requirements as new generation aircraft are put into operation (and older aircraft are retrofitted with updated technologies) – aircraft such as the B787 require a data connection to upload and download aircraft maintenance and performance information, weather conditions, aeronautical charts, and other flight information. The amount of data that is transferred in support of every flight is substantially greater than newer generation aircraft, taxiing the information technology (IT) infrastructure of many existing terminals/concourses.
- Apron planning impacts of wide scale conversion of ground service equipment to electric or other alternative fuel, particularly considering charging stations and technologies.

APPENDIX A LITERATURE SEARCH

An extensive search of existing regulatory guidance, applicable research, industry information, and practices at airports within the United States was completed during initial tasks of this study. The goal of this search was to collect comprehensive materials relating to the planning, design and operation of a variety of apron facilities. This resulted in a collection of materials from various government agencies, academic sources, aviation and airport organizations, airlines, and aircraft and equipment manufacturers. The literature list was subsequently explored in a later task that involved an evaluation of this material with the goal of identifying opportunities to enhance apron planning and design guidance (see Appendix B).

As the study progressed, additional information was uncovered and utilized to develop the Guidebook. The list below includes all pieces of literature that were utilized to develop the Guidebook. Those literature items that were included in the initial literature search and the evaluation of existing guidance, but not utilized in the development of the Guidebook are included in Appendix B. Those items not utilized in the development of the Guidebook generally contained redundant information (already covered in another source) or tangentially related information, but not directly applicable to apron planning and design as covered by this research effort.

(1) Airbus SAS, *Airplane Characteristics for Airport Planning*, November 13, 2013, http://www.airbus.com/support/maintenance-engineering/technical-data/aircraft-characteristics/

These documents provide airplane characteristics data for general airport planning.

(2) Airlines 4 America (formerly Air Transport Association), Specification 103, *Standard for Jet Fuel Quality Control at Airports*, 2009.

This document provides guidance for the storage and distribution of jet fuel at airports.

(3) Airlines for America (formerly Air Transport Association), *SG 908: Recommended Apron Markings and Identifications*, 2010.

This document provides guidance for ground support equipment movement and parking on the ramp. This publication covers the following areas requiring markings: service roads, pedestrian pathways, equipment restraint line, “No Parking” areas, Ground Support Equipment (GSE) parking areas, and aircraft engine intake hazard zones.

(4) Airport Cooperative Research Program, *Report 25, Airport Passenger Terminal Planning and Design*, 2010.

This report provides guidance in planning and developing airport passenger terminals and to assist users in analyzing common issues related to airport terminal planning and design.

(5) Airport Cooperative Research Program, *Report 38, Understanding Airspace, Objects, and Their Effects on Airports*, 2010.

This report provides information on understanding airspace surfaces and appropriate evaluation criteria to enhance the safety of the airport operating environment.

(6) Airport Cooperative Research Program, *Report 64, Handbook for Evaluating Emissions and Costs of APUs and Alternative Systems*, 2012.

This report provides an understanding of ground-based power, heating, and cooling systems to reduce the use of aircraft auxiliary power units.

(7) Airport Cooperative Research Program, *Synthesis 2, Airport Aviation Activity Forecasting*, 2007.

This document provides information on how airport forecasts are used and identifies common metrics, data sources and forecasting methods used within the industry.

(8) Airport Cooperative Research Program, *ACRP Synthesis 10, Airport Sustainability Practices*, 2008.

This synthesis study is intended to inform airport operators, stakeholders, and policy makers about a range of airport sustainability practices gathered from a literature review and web-based survey. It specifically targets airport operators and provides a snapshot of airport sustainability practices across the triple bottom line of environmental, economic, and social issues.

(9) Airports Council International, *Apron Markings and Signs Handbook*, 2009.

This handbook provides guidance on apron markings and signs and is intended for use by planners of apron areas, ground staff working on aprons, air traffic controllers, apron controllers, and pilots.

(10) Federal Aviation Administration, *Advisory Circular 20-35C, Tiedown Sense*, July 12, 1983.

This advisory circular provides information of general use on aircraft tiedown techniques and procedures.

(11) Federal Aviation Administration, *Advisory Circular 120-57A, Surface Movement Guidance and Control System*, December 19, 1996.

This advisory circular describes the standards and provides guidance in the development of a Surface Movement Guidance and Control System (SMGCS) plan for U.S. airports where scheduled air carriers are authorized to conduct operations when the visibility is less than 1,200 feet runway visual range.

(12) Federal Aviation Administration, *Advisory Circular 150-5070-6B Airport Master Plans*, May 1, 2007.

This advisory circular provides guidance for the preparation of master plans for airports that range in size and function from small general aviation to large commercial service facilities.

(13) Federal Aviation Administration, *Advisory Circular 150/5200-30C, Airport Winter Safety and Operations*, February 15, 2012.

This advisory circular provides guidance to assist airport operators in developing a snow and ice control plan, conducting and reporting runway friction surveys, and establishing snow removal and control procedures.

(14) Federal Aviation Administration, *Advisory Circular 150/5200-37, Introduction to Safety Management Systems (SMS) for Airport Operators*, February 28, 2007.

This advisory circular introduces the concept of a safety management system (SMS) for airport operators.

(15) Draft Advisory Circular 150/5200-37A, *Safety Management Systems for Airports*, June 29, 2012 (posted for industry comment).

This advisory circular provides detailed guidance about developing and implementing SMS on an airport and explains how SMS will help airports develop an explicit, pro-active, and

engaged process for identifying and quantifying potential hazards and risks and for managing them in a systematically coherent, logical, and reasonable way.

(16) Federal Aviation Administration, *Advisory Circular 150/5220-21C, Aircraft Boarding Equipment*, June 29, 2012.

This advisory circular contains performance standards, specifications, and recommendations for the design, construction, and testing of devices used in the boarding of airline passengers.

(17) Federal Aviation Administration, *Advisory Circular 150/5230-4B, Aircraft Fuel Storage, Handling, and Dispensing on Airports*, September 28, 2012.

This advisory circular identifies standards and procedures for storage, handling, and dispensing of aviation fuel on airports.

(18) Federal Aviation Administration, *Advisory Circular 150/5300-13A, Airport Design*, September 28, 2012.

This advisory circular contains FAA standards and recommendations for airport design.

(19) Federal Aviation Administration, *Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities*, February 5, 2008.

This advisory circular provides standards, specifications, and guidance for designing aircraft deicing facilities.

(20) Federal Aviation Administration, *Advisory Circular 150/5320-5C, Surface Drainage Design*, September 29, 2006.

This advisory circular provides guidance for engineers, airport managers, and the public in the design and maintenance of airport surface drainage systems.

(21) Federal Aviation Administration, *Advisory Circular 150/5320-6E, Airport Pavement Design and Evaluation*, September 30, 2009.

This advisory circular provides guidance to the public on the design and evaluation of pavements at civil airports.

(22) Federal Aviation Administration, *Advisory Circular 150/5340-1K, Standards for Airport Markings*, November 17, 2010.

This advisory circular contains the FAA standards for markings used on airport runways, taxiways, and aprons.

(23) Federal Aviation Administration, *Advisory Circular 150/5340-18F, Standards for Airport Sign Systems*, August 16, 2010.

This advisory circular contains standards for the siting and installation of signs on airport runways and taxiways, including taxiway ending markers, location signs, runway distance remaining signs, mandatory hold signs associated with POFZ and CAT II/III operations, and many others.

(24) Federal Aviation Administration, *Advisory Circular 150-5340-30F, Design and Installation Details for Airport Visual Aids*, September 29, 2011.

This advisory circular provides guidance and recommendations on the installation of airport visual aids.

(25) Federal Aviation Administration, *Advisory Circular 150/5360-9, Planning and Design of Airport Terminal Facilities at Non-Hub Locations*, April 4, 1980.

This advisory circular provides guidance material for the planning and design of airport terminal buildings at non-hub locations.

(26) Federal Aviation Administration, *Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities*, April 22, 1988.

This advisory circular provides guidelines for the planning and design of airport terminal buildings and related access facilities.

(27) Federal Aviation Administration, *Advisory Circular 150/5370-2F, Operational Safety on Airports During Construction*, September 29, 2011.

This advisory circular sets forth guidelines for operational safety on airports during construction activities.

(28) Federal Aviation Administration, *Advisory Circular 150/5370-17, Airside Use of Heated Pavement Systems*, March 29, 2011.

This advisory circular establishes minimum performance requirements for the design, construction, inspection, and maintenance of heated pavement systems for use in the air operations area (AOA).

(29) Federal Aviation Administration, *Advisory Circular 150/5380-6B, Guidelines and Procedures for Maintenance of Airports Pavements*, September 28, 2007.

This advisory circular provides guidelines and procedures for maintaining rigid and flexible airport pavements.

(30) Federal Aviation Administration, *Advisory Circular 150/5390-2C, Heliport Design*, April 24, 2012.

This advisory circular provides standards for the design of heliports serving helicopters with single rotors. Basic concepts can also be applied to facilities serving helicopters with tandem (front and rear) or dual (side by side) rotors; although many standards will not apply to these facilities.

(31) Federal Aviation Administration, *Engineering Brief 75: Incorporation of Runway Incursion Prevention into Taxiway and Apron Design*, November 19, 2007.

This engineering brief provides guidance on design strategies of taxiways and aprons to help prevent runway incursions.

(32) Federal Aviation Administration, *Environmental Desk Reference for Airport Actions*, October 2007.

This set of documents includes information to evaluate potential environmental impacts due to a proposed airport action. This reference set also provides information on mitigation measures.

(33) Federal Aviation Administration, *Memorandum, Airport Sustainable Master Plan Pilot Program*, March 27, 2010.

This memorandum provides preliminary guidance on airport sustainability planning.

(34) Federal Aviation Administration, *Memorandum, Interim Criteria for Precision Approach Obstacle Assessment and Category II/III Instrument Landing System Requirements*, August 16, 2011.

This memorandum provides interim criteria for the establishment of a Category II/III Instrument Landing System, including the definition of associated obstacle clearance surfaces.

(35) Federal Aviation Administration, *Order 1050.1E, Environmental Impacts: Policies and Procedures*, June 8, 2004.

This order provides Federal Aviation Administration policy and procedures to ensure compliance with environmental requirements Council on Environmental Quality (CEQ) regulations for implementing the provisions of the National Environmental Policy Act of 1969 (NEPA), 40 Code of Federal Regulations (CFR) parts 1500-1508; Department of Transportation Order DOT 5610.1C, Procedures for Considering Environmental Impacts; and other related statutes and directives.

(36) Federal Aviation Administration, *Order 5050.4B, NEPA Implementing Instructions for Airport Actions*, April 28, 2006.

This Order provides information on fulfilling National Environmental Policy Act (NEPA) requirements for airport actions.

(37) Federal Aviation Administration, *FAA Order 6310.6, Primary/Secondary Terminal Radar Siting Handbook*, May 13, 1982.

This handbook provides a complete and useful presentation of information necessary for the selection of terminal ASR/ATCBI radar sites to meet FAA operational requirements.

(38) Federal Aviation Administration, *FAA Order 6480.4A ATCT Siting Process*, April 10, 2006.

This order defines the methods used to complete the ATCT siting process in a consistent manner, and establishes the criteria and procedures for evaluation and approval of the height and location of an ATCT to ensure safety within the National Airspace System (NAS).

(39) Federal Aviation Administration, *Order 6750.16D, Siting Criteria for Instrument Landing Systems*, February 14, 2005.

This order provides guidance on siting Category I, II, or III instrument landing systems.

(40) Federal Aviation Administration, *FAA Order 8260.3B - United States Standard for Terminal Instrument Procedures (TERPS)*, July 7, 1979.

This order prescribes standardized methods for use in designing instrument flight procedures.

(41) Federal Aviation Administration, *Impact of New Large Aircraft on Airport Design*, March 1, 1998.

The report summarizes the impact of the introduction of proposed new large aircraft (NLA) on current airport design standards.

(42) Federal Aviation Administration, *Voluntary Airport Low Emission Program Technical Report*, December 2, 2010.

This report provides detailed information on project planning, the application process, and eligibility requirements for the Voluntary Airport Low Emission Program.

(43) Federal Aviation Administration, *Zero Emissions Airport Vehicles and Infrastructure Pilot Program, Technical Guidance*, Version 1, 2012.

This guidance provides information on the pilot program that allows the FAA to award grants for the acquisition and operation of zero emissions vehicles and associated infrastructure for the delivery of fuel and services.

(44) Illumination Engineering Society of North America, *The Lighting Handbook*, 2011.

This handbook provides is reference for lighting and lighting design for most facilities, including aircraft aprons.

(45) Innovative Pavement Research Foundation, *Airfield Marking Handbook*, September 19, 2008.

This handbook presents a set of practices that, when used, result in longer-performing pavement markings and increased safety.

(46) International Civil Aviation Organization, *Annex 14 to the Convention on International Civil Aviation, Aerodromes*, July 1, 2009.

Volume I contains Standards and Recommended Practices that prescribe the physical characteristics, obstacle limitation surfaces and visual aids to be provided at aerodromes, as well as certain facilities and technical services normally provided at an aerodrome. Volume II contains Standards and Recommended Practices covering aspects of heliport planning, design and operations.

(47) International Civil Aviation Organization, *Doc 9157 Aerodrome Design Manual, Part 2 - Taxiways, Aprons and Holding Bays*, 2005.

This document contains material on the general layout and description of the design criteria for taxiway physical characteristics, including taxiway fillets and shoulders, as well as typical apron layouts and their design requirements.

(48) National Fire Protection Association, *NFPA 407, Standard for Aircraft Fuel Servicing*, October 19, 2011.

This standard applies to the fuel servicing of all types of aircraft using liquid petroleum fuel. It does not apply to any of the following: (1) In-flight fueling (2) Fuel servicing of flying boats or amphibious aircraft on water (3) Draining or filling of aircraft fuel tanks incidental to aircraft fuel system maintenance operations or manufacturing.

(49) National Fire Protection Association, *NFPA 415, Standard on Airport Terminal Buildings, Fueling Ramp Apron Drainage and Loading Walkways*, 2008 Edition, 2007.

This standard specifies the minimum fire protection requirements for the construction and protection of airport terminal buildings. It specifies the minimum requirements for the design and maintenance of the drainage system of an aircraft fueling ramp to control the flow of fuel that can be spilled on a ramp and to minimize the resulting possible danger. In addition, it contains the minimum requirements for the design, construction, and fire protection of aircraft loading walkways between the terminal building and aircraft.

(50) Sustainable Aviation Guidance Alliance (SAGA), *Sustainability Database*, January 15, 2010.

The Sustainability Database consolidates various sources of airport-related sustainability practices into a single document, streamlining the ability to search, evaluate, and implement sustainable practices. The database can be searched and organized to correspond to the

sustainability goals of airports of all types and sizes. The database allows tailoring to the unique requirements of individual airports, but can also be shared by all airports to improve industry-wide knowledge of sustainable practices and to encourage an increased level of implementation.

(51) The Boeing Company, *Airplane Characteristics for Airport Planning*, November 13, 2012, http://www.boeing.com/boeing/commercial/airports/plan_manuals.page

These documents provide airplane characteristics data for general airport planning. It includes planning characteristics for aircraft built by McDonnell Douglas and Douglas Aircraft Company.

(52) Transportation Security Administration, *Recommended Security Guidelines for Airport Planning, Design, and Construction*, May 1, 2011.

This document provides guidance on subjects encompassing airport layouts, security screening, emergency response, access control, and communications.

(53) Transportation Security Administration, *Security Guidelines for General Aviation Airports*, May 1, 2004.

This document provides general aviation airport owners, operators, and users with guidelines and recommendations that address aviation security concepts, technology, and enhancements.

(54) U.S. Customs and Border Protection, *Airport Technical Design Standards Passenger Processing Facilities*, August 1, 2006.

These design standards are the primary reference document for the planning, design, renovation, and development of U.S. Customs and Border Protection facilities at airports.

(55) U.S. Government, *FAR 14 Code of Federal Regulations Part 77, Safe, Efficient Use and Preservation of the Navigable Airspace*, July 21, 2010.

This part establishes: (a) requirements to provide notice to the FAA of certain proposed construction, or the alteration of existing structures; (b) The standards used to determine obstructions to air navigation, and navigational and communication facilities; (c) The process for aeronautical studies of obstructions to air navigation or navigational facilities to determine the effect on the safe and efficient use of navigable airspace, air navigation facilities or equipment; and (d) The process to petition the FAA for discretionary review of determinations, revisions, and extensions of determinations.

APPENDIX B EVALUATION OF LITERATURE

After completing an extensive search of existing regulatory guidance, applicable research, industry information, and practices at airports within the United States (see Appendix A) an evaluation of this material was completed. The goal of this evaluation was to identify opportunities to enhance apron planning and design guidance. The evaluation completed in December 2012 is provided in this section.

ADDITIONAL LITERATURE

The list of literature items in this section are those used in the evaluation of existing guidance but not ultimately used in the development of the Guidebook. The sources used to develop the Guidebook are contained in Appendix A.

(1) Airport Cooperative Research Program, *ACRP Report 14, Deicing Planning Guidelines and Practices for Stormwater Management Systems*, 2009.

This report explores a wide array of practices designed to provide for the practical, cost-effective control of runoff from aircraft and airfield deicing and anti-icing operations.

(2) Airport Cooperative Research Program, ACRP Report 17, Airports and the Newest Generation of General Aviation Aircraft, 2009.

This report is designed to help airport operators assess the practical requirements and innovative approaches that may be needed to accommodate these new generation aircraft.

(3) Airport Cooperative Research Program, *ACRP Report 51, Risk Assessment Method to Support Modification of Aircraft Separation Standards*, 2011.

This report is intended to be used to support requests for modification of standards in those circumstances where the design criteria for separations between taxiways/taxilanes and other taxiways/taxilanes and/or fixed or movable objects, as well as separations between taxiways and runways, cannot be met.

(4) Airport Cooperative Research Program, *ACRP Report 62, Airport Management and Control Programs*, 2012.

The report compares and contrasts apron management programs around the world to U.S. airports, while considering the common operational and ownership differences between U.S. and non-U.S. airports.

(5) Airport Cooperative Research Program, *ACRP Research Results Digest 15, Use of Towbarless Tractors at Airports-Best Practices*, 2012.

This digest includes broad guidance designed to promote the safe operation of towbarless tractors at airports.

(6) Airports Council International, *Airside Safety Handbook 2010*, 2010.

This handbook outlines safety related policies and provides checklists for action, as well as an explanation of risks to be assessed and means of mitigation available.

(7) Embraer S.A., *Airport Planning Manuals*, November 13, 2012, http://www.embraercommercialjets.com/#/en/home

These documents provide airplane characteristics data for general airport planning.

(8) Federal Aviation Administration, *Advisory Circular 150/5100-13B, Development of State Standards for Nonprimary Airports*, August 31, 2011.

This advisory circular provides guidelines for the development of State standards and the use of State highway specifications for pavement construction at nonprimary public-use airports as provided for in Title 49 United States Code (USC), Sections 47105(c) and 47114(d)(5), respectively.

(9) Federal Aviation Administration, *Advisory Circular 150/5335-5B, Standardized Method of Reporting Airport Pavement Strength - PCN*, May 26, 2011.

This advisory circular provides guidance for using the standardized International Civil Aviation Organization (ICAO) method, called the Aircraft Classification Number – Pavement Classification Number (ACN-PCN) method, to report airport runway, taxiway, and apron pavement strength.

(10) Federal Aviation Administration, *Advisory Circular 150/5360-9, Planning and Design of Airport Terminal Facilities at Non-Hub Locations*, April 4, 1980.

This advisory circular provides guidance material for the planning and design of airport terminal buildings at non-hub locations.

(11) International Air Transport Association, *Airport Development Reference Manual*, January 2004.

This manual provides guidance on designing facilities with airport user needs in mind.

(12) International Civil Aviation Organization, *Doc 9137 Airport Service Manual, Part 1, Rescue and Fire Fighting*, 1990.

This document provides guidance for the implementation of the ICAO Annex 14, Volume I, specifications relating to rescue and firefighting.

(13) International Civil Aviation Organization, *Doc 9137 Airport Service Manual, Part 2, Pavement Surface Conditions*, 2002.

This document provides measures to ensure that adequate measures are taken to overcome problems resulting from contaminants on, or weathering of, the movement area.

(14) International Civil Aviation Organization, *Doc 9137 Airport Services Manual, Part 8, Airport Operational Services*, 1983.

This document summarizes the technical functions that are required to be fulfilled by an airport to ensure safety and continuity of operations.

(15) The UK Civil Aviation Authority, *CAP 637, Visual Aids Handbook*, May 01, 2007.

This document provides pilots and ground personnel engaged in the handling of aircraft with a general description of the purpose and meaning of visual aids that are typically displayed at aerodromes in the United Kingdom licensed by the Civil Aviation Authority.

(16) U.S. Government Accountability Office (GAO), *Aviation Runway and Ramp Safety, Sustained Efforts to Address Leadership, Technology, and Other Challenges Needed to Reduce Accidents and Incidents*, November 1, 2007.

This report summarizes the GAO's evaluation of factors affecting progress in runway and ramp safety, and what additional measures could be taken.

(17) Airfield Asphalt Pavement Technology Program, *AAPTP 05-03, Effect of Deicing Chemicals on HMA Airfield Pavements*, September 15, 2009.

The purpose of AAPTP Project 05-03 was to investigate the performance of hot mix asphalt (HMA) airfield pavements subjected to deicing and anti-icing chemicals (DIAIC). The most commonly used DIAICs include potassium acetate, sodium acetate, urea, and ethylene and propylene glycol.

(18) Airfield Asphalt Pavement Technology Program, *AAPTP Project 05-02, Fuel Resistant Sealers and Binders for HMA Airfield Pavements*, April 30, 2009.

The overall objective of AAPTP Project 05-02 was to review/improve test procedures for fuel resistant materials, develop performance-based evaluation criteria and provide technical guidance with respect to the application and use of non-coal tar-based fuel-resistant pavement sealers and binders.

(19) Airport Cooperative Research Program, *ACRP Synthesis 29, Ramp Safety Practices*, 2011.

This document addresses the current state of ground handling practices, focusing on safety measures and training. Issues covered include ramp safety operations, staff roles and responsibilities, safety training, audit and inspection programs, safety violation programs, and collaborative safety initiatives, such as foreign object debris programs.

(20) Airports Council International, *Airside Safety Handbook*, 2009.

This handbook is a guide to airside safety, complementing other materials available in the industry and defining best practices for enhancing safety and preventing accidents and incidents at airports.

(21) American Concrete Pavement Association, *Concrete Pavement for General Aviation, Business and Commuter Aircraft*, 2002.

This document summarizes concrete pavement design for general aviation aircraft, including advantages, subgrades, sub-bases, joints, construction, and overlays.

(22) Binghamton University-State University of New York, *Radiant Heating of Airport Aprons*, no date.

This document describes successful commercial radiant system installations and their potential for expanded installations to a scale suitable for airports.

(23) Federal Aviation Administration, *Advisory Circular 150-5060-5, Airport Delays*, September 23, 1983.

This advisory circular explains how to compute airport capacity and aircraft delay for airport planning and design.

(24) Federal Aviation Administration, *Advisory Circular 150-5070-7 The Airport System Planning Process*, November 10, 2004.

This advisory circular provides guidance for effective airport system planning.

(25) Federal Aviation Administration, *Advisory Circular 150-5210-24 Foreign Object Debris Management*, September 30, 2010.

This advisory circular provides guidance for developing and managing an airport foreign object debris (FOD) program. In addition, this Advisory Circular provides specifications for the equipment used in FOD removal operations.

(26) Federal Aviation Administration, *Advisory Circular 150/5210-5D, Painting, Marking, and Lighting of Vehicles Used on an Airport*, April 1, 2010.

This advisory circular provides guidance, specifications, and standards for the painting, marking, and lighting of vehicles operating in the air operations area (AOA). The approved lights, colors, and markings herein assure the conspicuity of vehicles operating in the AOA from both the ground and the air.

(27) Federal Aviation Administration, *Advisory Circular 150/5370-10F, Standards for Specifying Construction of Airports*, September 30, 2011.

This advisory circular provides standards for the construction of airports. Items covered in this Advisory Circular include general provisions, earthwork, flexible base courses, rigid base courses, flexible surface courses, rigid pavement, fencing, drainage, turfing, and lighting installation.

(28) Federal Aviation Administration, *Advisory Circular 150/5370-11B, Use of Nondestructive Testing in the Evaluation of Airport Pavements*, September 30, 2011.

This advisory circular focuses on nondestructive testing (NDT) equipment that measures pavement surface deflections after applying a static or dynamic load to the pavement. It also briefly introduces other types of nondestructive measuring equipment to illustrate how supplementing NDT data with other test data may improve the quality and reliability of the pavement evaluation.

(29) Federal Aviation Administration, *Advisory Circular 150/5370-13A, Off-Peak Construction Of Airport Pavements Using Hot-Mix Asphalt*, September 26, 2006.

This advisory circular provides guidance for the planning, coordination, management, design, testing, inspection, and execution of off-peak construction of airport pavements using hot-mix asphalt (HMA) paving materials. This circular focuses on HMA airfield pavement construction. The material contained herein also applies to other

(30) Federal Aviation Administration, *Advisory Circular 150/5370-16, Rapid Construction of Rigid (Portland Cement Concrete) Airfield Pavements*, September 28, 2007.

This advisory circular provides guidance for the planning, coordination, management, design, testing, inspection, and execution of rapid construction of rigid Portland Cement Concrete (PCC) airfield pavements. The material contained herein also applies to other types of airfield improvements where rapid construction is identified as the preferred construction method.

(31) Federal Aviation Administration, *Advisory Circular 150/5380-7A, Airport Pavement Management Program*, September 1, 2006.

This advisory circular discusses the Airport Pavement Management System (APMS) concept, its essential components, and how it can be used to make cost-effective decisions about pavement maintenance and rehabilitation.

(32) Federal Aviation Administration, *Design Guide Supplement Portland Cement Concrete*, October 2003.

This document supplements Advisory Circulars 150/5320-6 and 150/5320-5 for guidance in designing a PCC pavement.

(33) Federal Aviation Administration, *Evaluation of Retro-Reflective Beads to Increase Airport Surface Marking Conspicuity*, May 1, 2010.

This document summarizes the FAA's evaluation of various types of retro-reflective beads that are used to increase the conspicuity of painted markings when applied to airport surface markings.

(34) Federal Aviation Administration, *Evaluation of Thermoplastic Marking Materials*, May 1, 2008.

This document summarizes the FAA's evaluation of thermoplastic marking material as a potential alternative to the current water-based marking materials in use. The evaluation included retro-reflectivity, chromaticity, friction properties, and adherence to the airport pavement surface.

(35) Federal Aviation Administration, *FAA Order JO 711065U, Air Traffic Control*, February 9, 2012.

This order prescribes air traffic control procedures and phraseology for use by personnel providing air traffic control services.

(36) Innovative Pavement Research Foundation, *IPRF Report IPRF-01-G-002-1, Best Practices for Airport Portland Cement Concrete Pavement Construction (Rigid Airport Pavement)*, April 1, 2003.

This document summarizes best practices for the construction of durable and high quality airfield concrete pavement.

(37) International Council of Aircraft Owner and Pilot Associations (IAOPA), *Incorporating General Aviation into ICAO Annex 14, Aerodromes*, June 25, 2011.

This document summarizes the applicability of ICAO Annex 14 for general aviation.

(38) National Fire Protection Association, *Aircraft Fuel Hydrant System Design Issues*, January 12, 2005.

This presentation summary outlines design issues associated with aircraft fuel hydrant systems

(39) Portland Cement Association, *Design of Concrete Airport Pavement*, 1995.

This manual furnishes guidance for the design of concrete airport pavements, including receiving, storage and dispensing systems.

(40) Simtra, PathPlanner Literature, no date.

This literature provides information on the use of PathPlanner aircraft and vehicle maneuvering software.

(41) Society of Automotive Engineers, *Design and Operation of Aircraft Deicing Facilities*, June 28, 2004.

This document provides information and guidance material to assist in assessing the need for and feasibility of developing deicing facilities, the planning (sizing and siting) and design of deicing facilities, and assessing environmental considerations and operational considerations associated with deicing facilities.

(42) U.S. Department of Defense, *Unified Facilities Criteria 3-260-01, Airfield and Heliport Planning and Design*, November 17, 2008.

This manual provides standardized airfield, heliport, and airspace criteria for the geometric layout, design, and construction of runways, helipads, taxiways, aprons, and related permanent facilities for military facilities.

LITERATURE REVIEW

The literature review summary is presented in a standardized format that summarizes the limitations in the existing guidance that the Research Team identified during the literature review process, the opportunities for potential enhancements to existing guidance as the research effort progresses, and an assessment of whether the guidance material that was reviewed suggested specific information that could be pursued during the site visit process. The literature review summary is presented by topic: Apron Equipment, Design Implications and Considerations, Long-Term Considerations, Operational, Physical, Related Regulations, and Technology/Planning Tools.

In the cases of those subtopics for which source documents are listed but "none" is indicated under the Limitations, Enhancements, or Potential for Site Visits categories reflects the fact that upon review, the source documents no limitations, opportunities for enhancement, or site visit impacts were identified at this point in the review process. For simplicity, sources are shortened to title and page number (where provided).

APRON EQUIPMENT

Aircraft docking systems

Limitations:

- Specific information is provided manufacturers; guidance identified below provides general information on docking systems.

Enhancements:

- None

Potential for Site Visits:

- None – limited use in the United States.

Sources:

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities, Page 36

CAP 637, Visual Aids Handbook, Ch. 4

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 112

Airside Safety Handbook, Page 38

Cargo Equipment

Limitations:

- There are no guidelines for cargo equipment for helipads. (Helipads)
- Brief references to general aviation cargo equipment. (General Aviation)
- No guidance could be found for the minimum requirements for cargo equipment possibly due to the fact of multiple manufacturers of the cargo equipment. (All Aprons)

Enhancements:

- Provide general standard guidance on the minimum requirements of cargo equipment. (Terminal)
- Provide general standard guidance on the minimum requirements of cargo equipment. (All Aprons)

Potential for Site Visits:

- Inventory cargo loading equipment used at airports and various types of aprons. (Terminal)
- Inventory cargo loading equipment used at airports and various types of aprons. (All Aprons)

Sources:

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities, Page 36

CAP 637, Visual Aids Handbook, Ch. 4

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 112

Airside Safety Handbook, Page 38

Deicing equipment

Limitations:

- Specific guidelines for the use of deicing equipment for helipads were not available. (Helipads)
- Each document touches upon apron design and requirements for hub-airports and commercial service with little notation of application for GA airports. (General Aviation)
- Guidance and minimum requirements for deicing equipment was not available. This is probably due to multiple types of manufacturers. (All Aprons)

Enhancements:

- Continue search for relevant GA guidance. (General Aviation)
- Basic guidelines or standards could be created for the minimum requirements for deicing equipment. Explore installation and use of fixed boom for deicing. (All Aprons)

Potential for Site Visits:

- Inventory deicing equipment used at airports and various types of aprons. (All Aprons)

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities

CAP 637, Visual Aids Handbook, Page 19

ACRP Report 25, Airport Passenger Terminal Planning and Design

Airside Safety Handbook, Page 38

Design and Operation of Aircraft Deicing Facilities

Ground power

Limitations:

- FAA overview of ground equipment servicing commercial airliners and limited application for general aviation aircraft. Provides guidance on emission and power needs for various equipment. (General Aviation)
- There is little guidance on ground power units (GPUs) due to multiple manufacturers. (All Aprons)
- There is no guidance for ground power units for helipads. Per several manufacturers' websites, the voltage requirements for ground power units are Advisory Circular 115VAC/400Hz voltage for Electronic preflight checks and DC 28VDC voltage for Helicopter start and maintenance. (Helipads)

Enhancements:

- Provide description of general aviation applications for ground equipment which primarily revolves around
- Ground Power Units (generators), deicers, and heaters. (General Aviation)
- Provide general guidance on the size of the ground power units and ideal location for planning purposes around each gate. (All Aprons)
- Provide typical dimensions of ground power units for the planning of helipads. (Helipads)

Potential for Site Visits:

- Inventory ground power units used at airports and various types of aprons. (All Aprons)
- Inventory the different types of ground power units. (Helipads)

Sources:

ACRP Report 64, Handbook for Evaluating Emissions and Costs of APUs and Alternative Systems

ACRP Report 25, Airport Passenger Terminal Planning and Design, Pages 118-119

Cavotec Airfield Equipment, Pages 4-5

Advisory Circular 150/5300-13A, Airport Design, Pages 4-5

Hydrant fueling systems

Limitations:

- Specific guidance on hydrant fueling systems for helipads was not available. (Helipads)
- Vendors offer hydrant solutions for fuel dispensing for general aviation aircraft, but primarily used at commercial service airports; could have application for general aviation airports with large volume demands for Jet A fuel. ICAO provides some guidance general aviation airports on firefighting configuration and response protocols. (General Aviation)

Enhancements:

- Documentation offers environmental solutions for compliance with hydrant fueling systems. (General Aviation)

Potential for Site Visits:

- None

Sources:

NFPA 407, Standard for Aircraft Fuel Servicing

Doc 9137 Airport Service Manual, Part 1, Rescue and Fire Fighting, Page 10

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 120

Advisory Circular 150/5230-4A, Aircraft Fuel Storage, Handling, and Dispensing on Airports

Advisory Circular 150/5230-4B, Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports

NFPA Aircraft Fuel Hydrant System Design Issues

Lighting standards

Limitations:

- Limited guidance exists for apron lighting standards. Advisory Circular 150/5370-10F covers FAA criteria for airfield lighting systems but neglects apron lighting to taxiway and floodlighting for safety and security. (General Aviation)
- Lighting requirements will vary between different types of operations that are being performed but in general, lighting should follow guidelines outlined in ACRP Report 25 which reference *The Lighting Handbook* by the Illuminating Engineering Society. (All Aprons)
- The FAA has not evaluated floodlights for effectiveness in visual acquisition of a heliport. (Helipads)

Enhancements:

- Provide a table listing the minimum requirements of lighting depending on whether it is a cargo apron, deicing apron, helipads, maintenance apron, remote apron, or terminal apron. (All Aprons)
- Provide general guidance on the location of the lights, the types and illumination. (Helipads)

Potential for Site Visits:

- Review the types, locations and illumination used at other airports. (All Aprons)
- Evaluate the use of floodlights at helipads. Gather information about the placement, illumination and types of lights used. (Helipads)

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Page 10

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities, Page 48

ACRP Report 25, Airport Passenger Terminal Planning and Design

Advisory Circular 150/5390-2C, Heliport Design, Pages 121-122

Advisory Circular 150-5340-30F Design and Installation Details for Airport Visual Aids, Page 277

Advisory Circular 150/5370-10F, Standards for Specifying Construction of Airports, Part 11

UFC 3-260-01, Airfield and Heliport Planning and Design

Passenger loading bridges

Limitations:

- Detailed performance information on passenger loading bridges is limited to manufacturer information. (Terminal)

Enhancements:

- Explore available manufacturer equipment and determine impacts on apron planning. Considerations for extreme weather conditions (e.g., provide tie downs on apron or terminal buildings to allow bridges to be retracted and anchored in case of hurricane or other extreme conditions). (Terminal)

Potential for Site Visits:

- None

Sources:

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities, Page 36

Impact of New Large Aircraft on Airport Design, Page 35

SG 908: Recommended Apron Markings and Identifications, Page 12

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 123

Advisory Circular 150/5220-21C, Aircraft Boarding Equipment, Page 11

Limitations:

- Cavotec is private vendor offering commercial airline terminal services for power sources, PCA, Wet Services and Fuel. General aviation airports rarely offer PCA options due to complexity and cost. If a general aviation pilot wants air conditioning, small self-contained units are available throughout the marketplace. (General Aviation)
- There is little guidance on preconditioned air systems due to multiple manufacturers. (All Aprons)
- No guidance could be found for preconditioned air units for helipads. (Helipads)
- There is little guidance on preconditioned air systems due to multiple manufacturers. Preconditioned air systems can either be fixed to the jet bridge, on a mounted pedestal or cart mounted and are sized by aircraft. (Cargo)

Enhancements:

- Provide general guidance on the size of the preconditioned air system for planning purposes around each gate. (All Aprons)
- Provide general guidance on the size of the preconditioned air system for planning purposes around each gate. (Cargo)

Potential for Site Visits:

- Identify a GA operator that offers PCA for general aviation consumption and discuss pro/cons of service offering. (General Aviation)
- Inventory the different types of pre-conditioned air units used at airports. (All Aprons)
- Inventory the different types of pre-conditioned air units used at airports. (Cargo)

Sources:

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities

ACRP Report 25, Airport Passenger Terminal Planning and Design, Pages 118-119

Cavotec Airfield Equipment, Pages 6-7

DESIGN IMPLICATIONS AND CONSIDERATIONS

Constructability

Limitations:

- There is little or no guidance on constructability for airport projects. Providing a constructability review is a key step in the design process. Constructability reviews provides the client assurance that the project is both "biddable" and "buildable". (All Aprons)

Enhancements:

- Provide a general outline and checklists for holding constructability reviews for apron and helipad projects. (All Aprons)
- Need to establish Quality Control protocol for constructability and phasing elements of new and expanded apron construction. (All Aprons)

Potential for Site Visits:

- Discuss constructability issues with airport operators and/or apron designers.

Sources:

Advisory Circular 150/5370-11B, Use of Nondestructive Testing in the Evaluation of Airport Pavements

Advisory Circular 150/5370-13A, Off-Peak Construction of Airport Pavements Using Hot-Mix Asphalt

Advisory Circular 150/5370-2F, Operational Safety on Airports During Construction

Advisory Circular 150/5370-16, Rapid Construction of Rigid (Portland Cement Concrete) Airfield Pavements

IPRF Report IPRF-01-G-002-1, Best Practices for Airport Portland Cement Concrete Pavement Construction

Advisory Circular 150/5370-10F, Standards for Specifying Construction of Airports

Radiant Heating of Airport Aprons

Construction Phasing

Limitations:

- Database does not lend itself to apron design or construction phasing literature. Phasing would be a component of the engineer's construction plan. (General Aviation)
- There is a broad general guidance on the topic phasing but phasing is something that is unique to each project and should involve all the stakeholders that are impacted by the project. (All Aprons)

Enhancements:

- Need to establish Quality Control protocol for constructability and phasing elements of new and expanded apron construction. (General Aviation)
- Provide a general outline or matrix as guidance for phasing a project. General topics could include: stakeholders involved, impacts to operations, financial impacts to stakeholders, constructability and construction safety and phasing plans. (All Aprons)

Potential for Site Visits:

- Discuss construction phasing strategies with airport operators.

Sources:

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities

DRAFT Advisory Circular 150/5200-37A, Safety Management Systems for Airports

Advisory Circular 150/5200-37, Introduction to Safety Management Systems (SMS) for Airport Operators

Advisory Circular 150/5300-13A, Airport Design

Advisory Circular 150/5370-2F, Operational Safety on Airports During Construction, Pages 7-31

Advisory Circular 150/5370-10F, Standards for Specifying Construction of Airports, Page 70.13

Advisory Circular 150/5300-9B, Predesign, Prebid, and Preconstruction Conferences for Airport Grant Projects

Fuel pits / fuel lines

Limitations:

- Limited guidance on installation of fuel pits for general aviation airports. (All Aprons)

Enhancements:

- Provide guidance on minimum distances for fueling systems. (Helipads)
- Explore airline planning criteria for location of fuel pits. (Terminal)
- Investigate vendor product literature. Contact vendors for design specifications and installation to develop planning criteria. (All Aprons)

Potential for Site Visits:

- Review and evaluate fueling systems at helipads. (Helipads)

Sources:

NFPA 407, Standard for Aircraft Fuel Servicing

NFPA 415, Standard on Airport Terminal Buildings, Fueling Ramp Apron Drainage and Loading Walkways

Doc 9137 Airport Services Manual, Part 8, Airport Operational Services, Page 25

Advisory Circular 150/5390-2C, Heliport Design

Advisory Circular 150/5230-4A, Aircraft Fuel Storage, Handling, and Dispensing on Airports

Advisory Circular 150/5230-4B, DRAFT Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports

AAPTP Project 05-02, Fuel Resistant Sealers and Binders for HMA Airfield Pavements

UFC 3-260-01, Airfield and Heliport Planning and Design

Cavotec Airfield Equipment

Paint types

Limitations:

- The FAA report Evaluation of the Thermoplastic Marking Materials provides documentation on the best places to use thermoplastic markings but was mainly limited to runways and taxiways. (All Aprons)

Enhancements:

- There are different types of waterborne paint (Type I, Type II or Type III), glass bead types, epoxy, methacrylate, solvent-base, and preformed thermoplastic. It would be useful provide guidance if one is better than the other on aprons or helipads due to excessive traffic, deicing fluids, weather/environmental conditions, jet fuel and other chemicals that could damage the pavement marking. (All Aprons)

Potential for Site Visits:

- None

Sources:

SG 908: Recommended Apron Markings and Identifications

Doc 9157 Aerodrome Design Manual, Part 2 - Taxiways, Aprons and Holding Bays, Sections 3.5 and 4.3.6

Advisory Circular 150/5340-1K, Standards for Airport Markings

Advisory Circular 150/5390-2C, Heliport Design, Page 44

Apron Markings and Signs Handbook, Ch. 4

IPRF Report IPRF 01-G-002-05-1, Airfield Marking Handbook

Evaluation of Retro-Reflective Beads to Increase Airport Surface Marking Conspicuity

Evaluation of Thermoplastic Marking Materials

Advisory Circular 150/5370-10F, Standards for Specifying Construction of Airports, Page 371

Pavement design (slope, thickness, materials)

Limitations:

- FAA Advisory Circular 150/5320-6E goes into great detail on designing pavements, specifically breaking the design into different types of pavement sections and by weight of aircraft for runways and taxiways but doesn't go into any specifics about apron design. (All Aprons)
- Good mix of guidance and regulations toward consideration of variables for design. (General Aviation)

Enhancements:

- Provide separate general guidance on for pavement design of aprons. (All Aprons)

Potential for Site Visits:

- None

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities

Advisory Circular 150/5320-5C, Surface Drainage Design

Doc 9157 Aerodrome Design Manual, Part 2 - Taxiways, Aprons and Holding Bays, Ch. 3, Page 3-1

Advisory Circular 150/5300-13A, Airport Design, Pages 10, 36, 54, and 119

ACRP Report 25, Airport Passenger Terminal Planning and Design

Advisory Circular 150/5320-6E, Airport Pavement Design and Evaluation, Page 14,20,75,92

Advisory Circular 150/5390-2C, Heliport Design, Pages 169-173

Advisory Circular 150/5335-5B, Standardized Method of Reporting Airport Pavement Strength - PCN

Advisory Circular 150/5370-11B, Use of Nondestructive Testing in the Evaluation of Airport Pavements

Advisory Circular 150/5370-13A, Off-Peak Construction of Airport Pavements Using Hot-Mix Asphalt

Advisory Circular 150/5370-16, Rapid Construction of Rigid (Portland Cement Concrete) Airfield Pavements

IPRF Report IPRF-01-G-002-1, Best Practices for Airport Portland Cement Concrete Pavement Construction

AAPTP Project 05-02, Fuel Resistant Sealers and Binders for HMA Airfield Pavements, Pages 15 and 17

Advisory Circular 150/5370-10F, Standards for Specifying Construction of Airports

UFC 3-260-01, Airfield and Heliport Planning and Design

Radiant Heating of Airport Aprons

Design Guide Supplement Portland Cement Concrete

Design of Concrete Airport Pavement

Advisory Circular 150/5300-13A, Airport Design

Pavement maintenance

Limitations:

- None

Enhancements:

- None

Potential for Site Visits:

- Gather information from airports on how they implement their airport pavement management system (APMS) relative to apron pavements. (All Aprons)

Sources:

Advisory Circular 150/5200-30C, Airport Winter Safety and Operations, Pg. 13

Advisory Circular 20-35C, Tiedown Sense, Pg. 8

Advisory Circular 150/5380-7A, Airport Pavement Management Program

Advisory Circular 150/5380-6B, Guidelines and Procedures for Maintenance of Airports Pavements

AAPTP Project 05-02, Fuel Resistant Sealers and Binders for HMA Airfield Pavements

AAPTP 05-03, Effect of Deicing Chemicals on HMA Airfield Pavements

Radar

Limitations:

- There is no current guidance for siting ASDE installations. Information on other installations exists. (Terminal)

Enhancements:

- Discuss ASDE operation and considerations for apron areas with FAA staff. (Terminal)

Potential for Site Visits:

- None

Sources:

Advisory Circular 150/5300-13A, Airport Design, Page 66, 169-182

FAA Order 6310.6, Primary/Secondary Terminal Radar Siting Handbook

LONG-TERM CONSIDERATIONS

Aircraft fleet evolution

Limitations:

- Future aircraft fleet information is generally available from manufacturers, but often lacks specific airport planning information (e.g., wingspan, length, location of service points) until the aircraft is being manufactured. Manufacturers often publish reports that include general trends they foresee in increasing or changing physical or operational attributes of existing aircraft. (Terminal)

Enhancements:

- Description of overall increase in wingspans associated with wingtip devices and with new models of aircraft (as compared to existing aircraft models and their passenger capacities). (Terminal)

Potential for Site Visits:

- Inquiry as to the impacts and how airports are accommodating aircraft with wingtip devices and overall longer wingspans. (Terminal)

Sources:

ACRP Report 17, Airports and the Newest Generation of General Aviation Aircraft

Advisory Circular 150/5320-6E, Airport Pavement Design and Evaluation, Pages 14, 75, 92, and 109

Advisory Circular 150/5390-2C, Heliport Design

UFC 3-260-01, Airfield and Heliport Planning and Design, Page 8

Flexibility

Limitations:

- Considered as part of forecasting in an airport master planning, but specific guidance for planning apron facilities is not provided. (All Aprons)
- All related planning documents stress need for future forecasts to meet needs of aircraft mix using general aviation airport. (General Aviation)

Enhancements:

- Identify methods for apron planning that allow facilities to accommodate a wide range of aircraft and activities. (All Aprons)

Potential for Site Visits:

- Document how airports provide flexibility in the design and operation of their apron facilities. (All Aprons)

Sources:

ACRP Report 17, Airports and the Newest Generation of General Aviation Aircraft

Advisory Circular 150/5390-2C, Heliport Design

Advisory Circular 150-5070-6B, Airport Master Plans, Pages 39 and 51

UFC 3-260-01, Airfield and Heliport Planning and Design

OPERATIONAL

Aircraft maneuvers

Limitations:

- Consideration for maneuvering of ADG VI and possibly larger aircraft should be embellished. (Terminal)
- Specific guidance on helicopter maneuvers on helipads was not available. (Helipads)

Enhancements:

- None

Potential for Site Visits:

- None

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Pages 1-1.a, 19 4-2.b, and 2-1.a

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities, Pages 29-50

Impact of New Large Aircraft on Airport Design, Page 34

Apron Markings and Signs Handbook

Baggage systems

Limitations:

- Although baggage systems are typically located within terminal buildings, with automated components, input belts can exist on the terminal apron. Although though not widely used, these systems do exist. Guidance for planning of these facilities is limited to manufacturer information. (Terminal)

Enhancements:

- Identify airports with baggage input belts and equipment on the apron and inventory different layouts and configurations. (Terminal)

Potential for Site Visits:

- None, unless an examples can be found at an airport in the United States. (Terminal)

Sources:

ACRP Report 25, Airport Passenger Terminal Planning and Design

Deicing

Limitations:

- No specific guidance for remote aprons. Guidance for other aprons can be applied. (Remote)
- No specific guidance for maintenance aprons. Guidance for other aprons can be applied. (Maintenance)
- Advisory circular provides general guidelines for establishing a deicing facility but limits comments on general aviation facilities. (General Aviation)
- Specific guidance on deicing procedures for helipads was not available. (Helipads)
- No specific guidance for cargo apron. Guidance for other aprons can be applied. (Cargo)

Enhancements:

- Research and review how GA airports handle deicing and run-off. (General Aviation)
- Provide guidance on deicing procedures as they affect planning or design of facilities. (Helipads)

Potential for Site Visits:

- Inquiry about deicing on terminal aprons, including effects on building (cleaning) and safety of workers in vicinity of deicing activities when considering implementation of on-gate deicing. (Terminal)
- Visit GA airport where operator (FBO, sponsor, etc.) conducts deicing operations and how apron is designed to conduct ops and collect run-off. (General Aviation)
- Inquiry about deicing on cargo aprons. (Cargo)

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Pages 1-32

CAP 637, Visual Aids Handbook, Ch. 4

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 112

Airside Safety Handbook, Page 36, 38

Design and Operation of Aircraft Deicing Facilities

Ground passenger loading

Limitations:

- Limited guidance on practices to ensure safety of passengers and security of airport. (Terminal)

Enhancements:

- Provide minimum requirements for passenger walkways. Including width, grade and ADA requirements. (Helipads)

Potential for Site Visits:

- Observe ground loading operations and identify any operational or safety practices in use. (Terminal)
- Review the layout of passenger walkways and standards. (Helipads)

Sources:

Advisory Circular 150/5360-9, Planning and Design of Airport Terminal Facilities at Non-Hub Locations

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 110,126

Advisory Circular 150/5390-2C, Heliport Design

UFC 3-260-01, Airfield and Heliport Planning and Design

Hand-off points

Limitations:

- Specific guidance on hand-off points is not available for helipads (Helipads)

Enhancements:

- None

Potential for Site Visits:

- None – discussion with air traffic control staff.

Sources:

FAA Order JO 711065U, Air Traffic Control

Interface with non-apron areas (taxiways, taxilanes, pushback areas, etc.)

Limitations:
Enhancements:
Potential for Site Visits:

- Discuss movement and non-movement boundaries with airport operators

Sources:

UFC 3-260-01, Airfield and Heliport Planning and Design

Advisory Circular 150/5300-13A

Engineering Brief 75, Incorporation of Runway Incursion Prevention into Taxiway and Apron Design

Jet blast constraints / considerations

Limitations:

- Planners must rely on manufacturer data for specific jet blast information. (All Aprons)
- There is limited guidance on jet blast constraints or considerations from helicopters. For the design of helipads, rotor wash needs to be considered. Safety areas should be treated to prevent loose stones and any other flying debris. (Helipads)

Enhancements:

- Provide recommendations of the most effective means of blast protection. (All Aprons)
- Provide guidance on how to limit the effects of rotor wash from helicopters. (Helipads)

Potential for Site Visits:

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Page 15

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities

Airplane Characteristics for Airport Planning

Advisory Circular 150/5300-13A, Airport Design, Ch. 8

ACRP Report 25, Airport Passenger Terminal Planning and Design

Advisory Circular 150/5390-2C, Heliport Design

UFC 3-260-01, Airfield and Heliport Planning and Design

Ramp towers

Limitations:

- Although similar to airport traffic control tower planning, specific guidance on planning ramp towers (location, height, etc.) is not available. (All Aprons)

Enhancements:

- Develop specific guidance for the planning of ramp towers. (All Aprons)

Potential for Site Visits:

- Discuss siting of ramp towers with airport operators.

Sources:

ACRP Report 62, Airport Management and Control Programs

Security

Limitations:

- On a daily basis, airlines face suspicious material threats. It would be beneficial if there was a type of designated area near the terminal apron where searches can be conducted safely without relocation the aircraft or baggage. (Terminal)

Enhancements:

- None

Potential for Site Visits:

- Inventory aprons at existing airport where vehicle and aircraft searches are conducted. (Terminal)
- Document security measures taken at helipads. (Helipads)

Sources:

Advisory Circular 150/5360-9, Planning and Design of Airport Terminal Facilities at Non-Hub Locations

Advisory Circular 150/5390-2C, Heliport Design

Advisory Circular 150-5070-6B, Airport Master Plans

Advisory Circular 150-5070-7, The Airport System Planning Process

UFC 3-260-01, Airfield and Heliport Planning and Design

TSA Recommended Security Guidelines for Airport Planning, Design, and Construction

Snow removal

Limitations:

- None

Enhancements:

- Guidance and design criteria should be provided for storm water runoff for snow melting operations. This should include adequate size pipe, sewer cover design that allows for massive amount of water runoff from the melter. Considerations for snow removal (push and pile, haul out (trucking), melting) should be discussed in the early planning and design of an apron should be enhanced. (Terminal)
- Provide minimum design standards that snow needs to be removed around a helipad to avoid swirling snow and obstruction hazards. (Helipads)

Potential for Site Visits:

- Collect and document snow removal operation considerations for apron facilities. (Terminal)
- Talk with airport maintenance about their snow removal procedures. (Helipads)

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities

Advisory Circular 150/5200-30C, Airport Winter Safety and Operations, Pg. 20, Par. 1

Doc 9137 Airport Service Manual, Part 2, Pavement Surface Conditions, Chapter 7

Advisory Circular 150/5390-2C, Heliport Design

Surface Movement Guidance Control System

Limitations:

- The various visual aids and markings handbooks discussion of apron markings for general aviation are limited. (General Aviation)
- As listed in the ACI Marking and Signs Handbook, some of the descriptions of the color coding are contradictory to the FAA Standards. Red is described as “Indicates that a vehicle must not cross except a clearance by ATC is received". The FAA utilizes the yellow movement/non movement boundary line for this purpose. (All Aprons)
- The is no specific guidance on surface movement guidance control systems for helipads. (Helipads)

Enhancements:

- Standardized guidance on pavement and gate marking could enhance SMGCS consideration in apron planning and design. (All Aprons)

Potential for Site Visits:

- Document utilization and policies for SMGCS procedures used by airport for general aviation operations. (General Aviation)

Sources:

Advisory Circular 120-57A, Surface Movement Guidance and Control System, Pages 19-21

CAP 637, Visual Aids Handbook, Ch. 2, Pg. 5 2.4

Apron Markings and Signs Handbook, Par. 6 2.1,43,44

Vehicle circulation

Limitations:

- Advisory circulars do not specifically mention vehicle operations for general aviation airports. (General Aviation)
- Specific guidance for vehicle circulation was not available. (Helipads)

Enhancements:

- Most U.S. general aviation airports do not require permits for vehicles to access an apron area while some sort of permit is required at Part 139 airports. Several incursions occur at smaller general aviation airports from tenants driving on active pavements. This might be a procedure that smaller airports incorporate into lease agreements or into their airfield access SOP's (General Aviation)
- Enhance design criteria for placement of vehicle service roads and blast fences. (Terminal)
- Develop guidance for vehicle circulation around helipads. (Helipads)

Potential for Site Visits:

- Observe vehicle operations on aprons and discuss driving rules with various airports to determine common practices. (Terminal)

Sources:

Doc 9137 Airport Services Manual, Part 8, Airport Operational Services, Ch. 10, Pg. 23 Par. 10.2.2, Pg. 45, Par.

ACRP Research Results Digest 15, Use of Towbarless Tractors at Airports-Best Practices

Advisory Circular 150/5340-1K, Standards for Airport Markings

PHYSICAL

Aeronautical surfaces/areas (TERPS, Part 77, obstacle free zone, runway areas)

Limitations:

- None

Enhancements:

- Provide illustrations of surfaces for preliminary planning purposes, especially for more complex surfaces associated with instrument approaches. (All Aprons)

Potential for Site Visits:

- None

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Page 12

Annex 14 to the Convention on International Civil Aviation, Aerodromes, Pages 3-18

Advisory Circular 150/5300-13A, Airport Design, Pages 12-13

Advisory Circular 150/5390-2C, Heliport Design

FAR 14 Code of Federal Regulations Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace

FAA Order 8260.3B - United States Standard for Terminal Instrument Procedures (TERPS)

UFC 3-260-01, Airfield and Heliport Planning and Design

Aircraft clearances / separations

Limitations:

- The separations provided in the documents are all general. No remote apron specific separations/clearances could be found. (Remote)
- The separations provided in the documents are all general. No maintenance apron specific separations/clearances could be found. (Maintenance)
- Clearances and separations for helipads vary based on the length and rotor diameter of the design helicopter. (Helipads)
- The separations provided in the documents are all general. No cargo apron specific separations/clearances could be found. (Cargo)

Enhancements:

- Separations for maintenance ramps taking into account equipment and personnel working on and around the aircraft. (Maintenance)
- Enhance existing guidance to specify clearance/separation of aircraft based on types of activities occurring around aircraft; i.e., a deicing ramp may need more separation around aircraft to maneuver boom vehicles while a remote parking ramp may need less separation. (Cargo)

Potential for Site Visits:

- ORD - Northwest Maintenance Hangar Area (Maintenance)
- Discuss aircraft clearance policies with airport operators

Sources:

ACRP Report 51, Risk Assessment Method to Support Modification of Aircraft Separation Standards

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Pages 3 and 9

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities, Page 30

Impact of New Large Aircraft on Airport Design, Pages 29 and 34

SG 908: Recommended Apron Markings and Identifications, Page 14

Annex 14 to the Convention on International Civil Aviation, Aerodromes, Pages 3-17

Advisory Circular 150/5300-13A, Airport Design, Page 10

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 101

Advisory Circular 150/5390-2C, Heliport Design

UFC 3-260-01, Airfield and Heliport Planning and Design

Airport traffic control and ramp tower line of sight

Limitations:

- Guidance on location of ramp towers was not available. (Helipads)
- Specific information with regards to line of sight for ramp towers is not provided. (Cargo)

Enhancements:

- Develop guidance of ramp tower for helipads. (Helipads)
- Develop list of considerations for placement of ramp towers or construction of aprons near existing ramp towers. (Cargo)

Potential for Site Visits:

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Page 4

Advisory Circular 150/5360-9, Planning and Design of Airport Terminal Facilities at Non-Hub Locations

Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities, Page 4

Annex 14 to the Convention on International Civil Aviation, Aerodromes, Page 3-18

Advisory Circular 150/5300-13A, Airport Design, Pages 36 and 65

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 101

FAA Order 6480.4A ATCT Siting Process

Building clearances / separations

Limitations:

- Guidance is limited on clearances/separation of roadways at heliports. (Helipads)
- Specific building clearances are only provided for building restriction lines and taxiway/taxilane to fixed or movable object. (Cargo)

Enhancements:

- Provide a chart or table with basic guidelines and formulas to calculate the TLOF, FATO, HPZ and safety area size. (Helipads)
- Develop building clearance standards for apron specific applications considering activities on aprons. (Cargo)

Potential for Site Visits:

- Observer and document building clearances at various airports and aprons. (Cargo)

Sources:

ACRP Report 51, Risk Assessment Method to Support Modification of Aircraft Separation Standards

Annex 14 to the Convention on International Civil Aviation, Aerodromes, Page 3-17

Advisory Circular 150/5300-13A, Airport Design, Page 12

Advisory Circular 150/5390-2C, Heliport Design

UFC 3-260-01, Airfield and Heliport Planning and Design

Emergency vehicle access

Limitations:

- Limited literature available on apron planning for emergency vehicle access. (All Aprons)

Enhancements:

Potential for Site Visits:

- Determine if site visit airports plan or accommodate access for emergency vehicles. (All Aprons)

Sources:

NFPA 415, Standard on Airport Terminal Buildings, Fueling Ramp Apron Drainage and Loading Walkways

GSE staging / storage

Limitations:

- Little guidance is available for planning GSE staging areas since requirements are generally determined in consultation with airlines or tenants. (All Aprons)
- There is no guidance for staging or storing of ground service equipment for heliports. (Helipads)

Enhancements:

- Develop inventory checklist for GSE

Potential for Site Visits:

- None

Sources:

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 120

Advisory Circular 150/5390-2C, Heliport Design

UFC 3-260-01, Airfield and Heliport Planning and Design

Maneuvering areas

Limitations:

- There was no specific information for any apron areas other than standard separations. (All Aprons)

Enhancements:

- Provide general radii and area required for ground vehicle movements. (All Aprons)

Potential for Site Visits:

- None

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities

Impact of New Large Aircraft on Airport Design, Page 29

Engineering Brief 75: Incorporation of Runway Incursion Prevention into Taxiway and Apron Design, Page 12

Advisory Circular 150/5300-13A, Airport Design, Chapter 4

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 101

Advisory Circular 150/5390-2C, Heliport Design

Airside Safety Handbook, Page 36

UFC 3-260-01, Airfield and Heliport Planning and Design

Markings (lead-in, lead-out, stop bars, safety envelopes)/In-pavement lighting

Limitations:

- There is some inconsistency between international airports and those in the United States. (Terminal)

Enhancements:

- Contact airlines to determine marking standards and best practices. (Terminal)

Potential for Site Visits:

- Observe different markings on various aprons. (Terminal)

Sources:

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Page 9

Advisory Circular 120-57A, Surface Movement Guidance and Control System

CAP 637, Visual Aids Handbook, Ch. 2, Pg. 5

SG 908: Recommended Apron Markings and Identifications

Annex 14 to the Convention on International Civil Aviation, Aerodromes, Pages 5-12 and 5-53

Advisory Circular 150/5340-1K, Standards for Airport Markings, Chapters 1, 4, and 5

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 108

Advisory Circular 150/5390-2C, Heliport Design, Pages 88-102

Apron Markings and Signs Handbook

Airside Safety Handbook, Page 36

Advisory Circular 150-5340-30F Design and Installation Details for Airport Visual Aids, Page 19

UFC 3-260-01, Airfield and Heliport Planning and Design

Safety areas / object free areas

Limitations:

- None – clearly defined in advisory circular.

Enhancements:

- None

Potential for Site Visits:

- None

Sources:

Advisory Circular 150/5300-13A, Airport Design, Pages 12 and 33

Advisory Circular 150/5390-2C, Heliport Design

UFC 3-260-01, Airfield and Heliport Planning and Design

Signage

Limitations:

- None

Enhancements:

- None

Potential for Site Visits:

- Explore unique applications for apron signage

Sources:

Advisory Circular 150/5390-2C, Heliport Design

FAR 14 Code of Federal Regulations Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace

Advisory Circular 150/5340-18F, Standards for Airport Sign Systems

Tie-downs

Limitations:

- Guidance is limited for the placement of tie down anchors for fleet flexibility. (General Aviation)

Enhancements:

- None

Potential for Site Visits:

- Observe tie down aprons and discuss layouts that work with aprons with a variety of aircraft. (General Aviation)

Sources:

Advisory Circular 20-35C, Tiedown Sense

Vehicle roadways clearances / separations

Limitations:

- Guidance is limited on clearances/separation of roadways. (Helipads)

Enhancements:

- Provide a chart or table with basic guidelines and formulas to calculate the TLOF, FATO, HPZ and safety area size. (Helipads)
- There could be more guidance on vehicle roadways located on apron areas or immediately adjacent to aircraft parking areas. (All Aprons)

Potential for Site Visits:

Sources:

ACRP Report 51, Risk Assessment Method to Support Modification of Aircraft Separation Standards

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities, Page 19

Annex 14 to the Convention on International Civil Aviation, Aerodromes, Pages 3-17

Advisory Circular 150/5300-13A, Airport Design, Page 10

ACRP Report 25, Airport Passenger Terminal Planning and Design, Page 113

Advisory Circular 150/5390-2C, Heliport Design

UFC 3-260-01, Airfield and Heliport Planning and Design

RELATED REGULATIONS

Environmental regulations

Limitations:

- None

Enhancements:

- None

Potential for Site Visits:

- None

Sources:

NFPA 407, Standard for Aircraft Fuel Servicing

NFPA 415, Standard on Airport Terminal Buildings, Fueling Ramp Apron Drainage and Loading Walkways

Advisory Circular 150/5300-14B, Design of Aircraft Deicing Facilities

ACRP Report 64, Handbook for Evaluating Emissions and Costs of APUs and Alternative Systems, Page 12

Voluntary Airport Low Emission Program Technical Report

ACRP Report 25, Airport Passenger Terminal Planning and Design, Ch. 18

ACRP Report 14, Deicing Planning Guidelines and Practices for Stormwater Management Systems

Advisory Circular 150/5230-4A, Aircraft Fuel Storage, Handling, and Dispensing on Airports

Advisory Circular 150-5070-6B Airport Master Plans, Page 24

FAA Order 5050.4B, National Environmental Policy Act Implementing Instructions for Airport Actions

FAA Order 1050-1E, Environmental Impacts: Policies and Procedures

International Civil Aviation Organization

Limitations:

- None

Enhancements:

- None

Potential for Site Visits:

- None

Sources:

Annex 14 to the Convention on International Civil Aviation, Aerodromes

Doc 9157 Aerodrome Design Manual, Part 2 - Taxiways, Aprons and Holding Bays

Doc 9137 Airport Service Manual, Part 1, Rescue and Fire Fighting

Doc 9137 Airport Service Manual, Part 2, Pavement Surface Conditions

Incorporating General Aviation into ICAO Annex 14, Aerodromes

National Fire Protection Association

Limitations:

- None

Enhancements:

- None

Potential for Site Visits:

- None

Sources:

NFPA 407, Standard for Aircraft Fuel Servicing

NFPA 415, Standard on Airport Terminal Buildings, Fueling Ramp Apron Drainage and Loading Walkways

Safety Management Systems

Limitations:

- Draft is aimed at Part 139 operators, but provides examples of safety resource risk management examples with general aviation activities. (All Aprons)

Enhancements:

- Find FAA guidance on SMS best practices and guidance for GAs. Review FAA's NPR docket no. FAA-2010-0997;
- Notice No. 10-14 (All Aprons)

Potential for Site Visits:

- If implemented at site visit airport, collect information on SMS program and applicability to apron planning and operation. (Terminal)

Sources:

DRAFT Advisory Circular 150/5200-37A, Safety Management Systems for Airports

ACRP Report 62, Airport Management and Control Programs, Pages 8, 9, and 12-15

Advisory Circular 150/5200-37, Introduction to Safety Management Systems (SMS) for Airport Operators

Advisory Circular 150/5100-13B, Development of State Standards for Nonprimary Airports, Page 48

Sustainability

Limitations:

- ACRP Synthesis 10 is geared toward large, med, and small airports with limited sustainability practices. General aviation is not covered in this document. (General Aviation)

Enhancements:

- None

Potential for Site Visits:

- Inquire with site visit airports as to policies that incorporate sustainability. (All Aprons)

Sources:

ACRP Synthesis 10, Airport Sustainability Practices, Appendix D-2

Doc 9137 Airport Services Manual, Part 8, Airport Operational Services, Page 27

ACRP Report 64, Handbook for Evaluating Emissions and Costs of APUs and Alternative Systems

Voluntary Airport Low Emission Program Technical Report, Pages 6-1, 6-3, 9-11, 9-12, and viii

ACRP Report 25, Airport Passenger Terminal Planning and Design, Pages 48, 53, and 58-68

Sustainability Database

TECHNOLOGY / PLANNING TOOLS

Aircraft and vehicle maneuvering simulation software

Limitations:

- The simulation software (Pathplanner, AeroTurn) for aircraft and vehicle maneuvering is proprietary and the user manuals are not available. (All Aprons)

Enhancements:

- None

Potential for Site Visits:

- None

Sources:

PathPlanner Literature

Computer aided design (CAD)

Limitations:

- Guidance for programs appear out of date. (All Aprons)

Enhancements:

- Possibly generate a listing of computer programs & specialized programs to assist with Computer Aided Design (All Aprons)

Potential for Site Visits:

- None

Sources:

AutoCAD Literature

Pavement strength software

Limitations:

- Literature on pavement strength software is limited. (All Aprons)
- FAA standardized process to calculate PCN for aircraft weighing less than 12,500 pounds. Software/design support to facilitate design of aprons serving aircraft weighing in excess of 12,500 lbs. - i.e., business jets which frequent community general aviation facilities. (General Aviation)

Enhancements:

- Collect additional literature from software vendors to determine benefits for apron pavement design (All Aprons)

Potential for Site Visits:

- None

Sources:

Airport Planning Manuals

Advisory Circular 150/5390-2C, Heliport Design, Page 96

Advisory Circular 150/5335-5B, Standardized Method of Reporting Airport Pavement Strength - PCN, Page 90

UFC 3-260-01, Airfield and Heliport Planning and Design, Pages 127-144

APPENDIX C APRON OBSERVATIONS

BATON ROUGE METROPOLITAN AIRPORT

Figure C-1 Baton Rouge Metropolitan Airport Aerial Image
Source: Google Earth Pro.

Terminal Apron

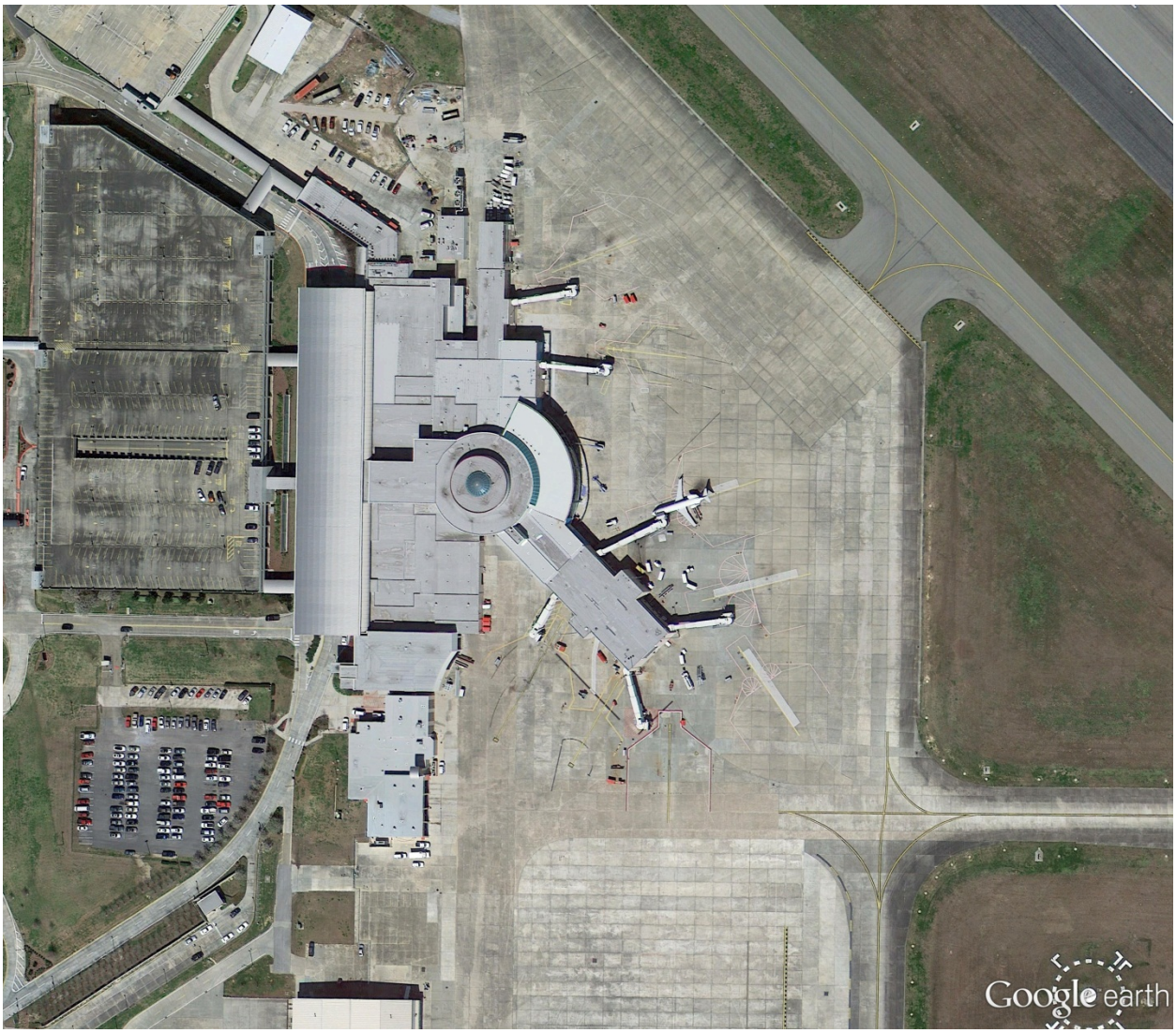

Figure C-2 Baton Rouge Metropolitan Airport Terminal Apron
Source: Google Earth Pro.

Description

Located in the northwestern portion of East Baton Rouge Parish, approximately 5 miles north of downtown, Baton Rouge Metropolitan Airport (BTR or the Airport) is adjacent to Interstate 110 and surrounded by three four-lane highways: Louisiana 67, Louisiana 408, and Veterans Boulevard. The passenger terminal is located on the west side of the airfield. The area south of the airfield is primarily designated for general aviation use, as well as the location of the FAA Air Traffic Control Tower (ATCT). The east side of the airfield consists of general aviation facilities, an Atlantic Southeast Airlines regional jet maintenance facility, and the Transportation Security Administration offices. The north side of the airfield encompasses vacant land owned by the Airport for future development.

The Airport has two runways for air carrier operations: Runway 13/31 and Runway 4L/22R. Parallel taxiways to the runways provide access to the south and east general aviation areas.

The airport has approximately 18 acres of apron available for aircraft parking at the passenger terminal. The apron is currently configured to accommodate aircraft ranging from the Boeing 757 to regional jets. Currently 13 to 16 aircraft parking positions are available near the terminal for aircraft remaining overnight (RON). Immediately adjacent to the terminal apron is approximately 10 acres of cargo apron. Both aprons are constructed of concrete.

Operational Challenges / Physical Influences:

As a former military airport with crosswind runways there are existing pavements areas that are currently unusable for aircraft operations due to pavement condition. Airport Management is of the opinion that parallel runways would provide a better configuration for apron operations to utilize available land. While this airport is located in a southern climate there are still needs for deicing. There is a deicing area at the intersection of Taxiways A and Q but not on or adjacent to the apron. There is a trench drain in the terminal apron but it does not have the required oil/water separator to support deicing operations. This may be converted in the future to allow aircraft deicing at the terminal.

Operational Practices

As stated above the terminal apron is configured such that it can accommodate various sized commercial aircraft. Airport personnel do not get involved with airline operations.

Strengths

While the shape of the apron is considered a challenge by Airport Management because of the inability to maximize utilization of available land, the apron configuration is also considered a strength given its multiple access points to the airfield. Concrete construction reduces the amount of maintenance required and provides a long life pavement.

Other Information

The airline representatives contacted during this research indicated that there is ample room to maneuver GSE around parked aircraft and that the apron is large enough to accommodate scheduled aircraft at BTR. Also, airline representatives indicated that safety in and around the airport environment is viewed positively. Airlines would like to be able to deice aircraft at the Terminal.

General Aviation Apron

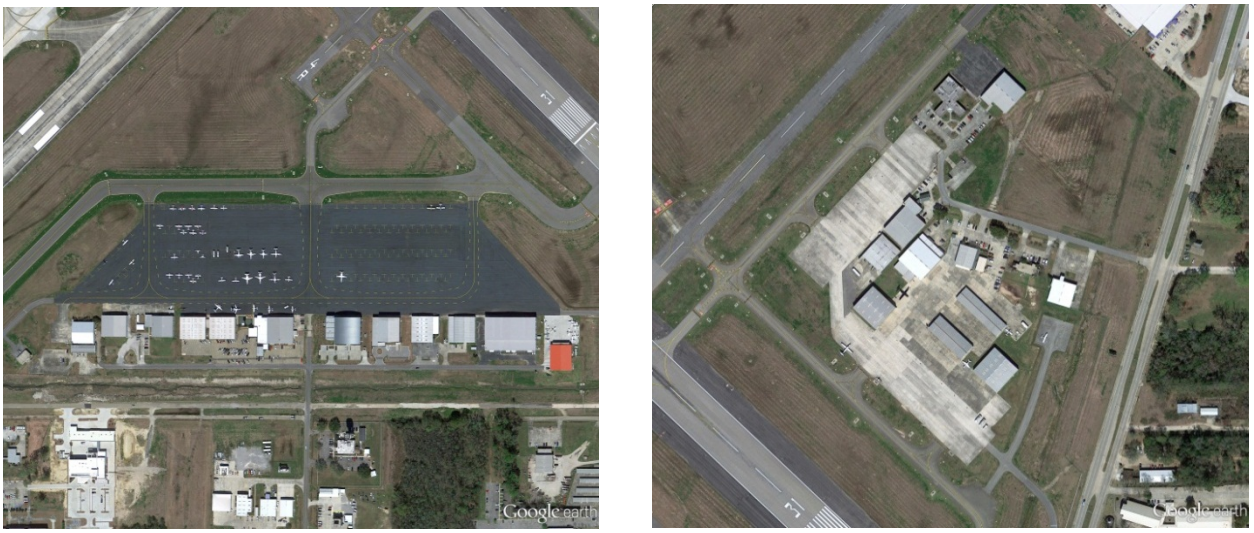

Figure C-3 Baton Rouge Metropolitan Airport General Aviation Aprons
Source: Google Earth Pro.

Description

There are two general aviation apron areas, both of which are located away from the commercial airline and cargo areas. Both of these aprons have hangars adjacent to them. The eastern apron is the smaller apron of the two and typically accommodates transient aircraft. The apron is constructed of both asphalt and concrete. The southern apron has tie-down spaces for based aircraft as well as transient aircraft and is constructed of asphalt.

Operational Challenges / Physical Influences

Currently there is sufficient apron space available to meet current demand but there is concern by Airport management regarding the future availability of land due to the constraints of the runway layout. The ATCT is located just south of the southern apron.

Two FBOs provide fueling services. Louisiana Aircraft, LLC provides services during the hours of 5:00 a.m. to 10:00 p.m. with services available outside of these hours for an additional fee. PAI Aero is an assisted self-service FBO and has 24-hour self-service for 100LL Avgas.

Operational Practices

The general aviation aircraft parking aprons are separated from the commercial/cargo apron so that operational conflicts are avoided. The FBOs both move and control the movement of aircraft on the aprons. There is adequate apron space available for maneuvering aircraft. However, during home football games at Louisiana State University, which generates substantial transient traffic, the aprons are often occupied to capacity.

Strengths

The aprons have historically been adequate to support general aviation operations and with multiple entry/exit taxiways linking the apron areas to the airfield, aircraft can typically maneuver without conflict. The general aviation aprons are separated from the commercial/cargo apron so that operational conflicts are avoided.

Other Information

The southern apron is in need of seal coating as pavement maintenance measure. While this type of work can be accomplished in a short amount of time, the Airport must find adequate space for existing aircraft to be relocated and tied down during the work period. This challenge will be more difficult in the future when this same apron requires either pavement rehabilitation (mill and overlay) or reconstruction in several years.

CENTENNIAL AIRPORT

General Aviation Apron

Figure C-4 Centennial Airport Aerial Image
Source: Google Earth Pro.

Description

Centennial Airport (APA or the Airport) is a general aviation reliever airport to Denver International Airport. With three runways and four major Fixed Base Operators (FBOs), the Airport is the third busiest general aviation airport in the country. Located 13 miles south of downtown Denver and near the Denver Tech Center, the Airport also offers several aviation-related services including a number of flight schools, flying clubs, air charter services, aircraft sales services and aircraft maintenance services, as well as being an important hub for commerce and trade.

Operational Challenges / Physical Influences

A diverse fleet mix of general aviation aircraft operate at the Airport. There are 880 based aircraft that include single and multi-engine piston airplanes, corporate business jets, and helicopters.

Corporate flight departments and aviation-related business have flourished over the years resulting in distinct areas of hangar and apron development. This is evidenced by the establishment of the four fixed base operators (FBOs).

The original FBOs, the Denver jetCenter and TAC Air, are located along in the northern half of the airport. FBOs Signature Flight Support and X Jet are located in a development area on the opposite side of the crosswind runway that was constructed within the last 10 years. As airport activity has grown, the two original FBOs have incrementally expanded by building and purchasing hangars and aprons adjacent to their main terminals, which has created some aircraft ground movement issues because the FBO facilities have not followed a defined, cohesive, and efficient development plan.

The spread of business and storage hangars and aprons presents challenges for landside access, security, operational movements to/from runways, and congestion. The apron terrain is generally compatible; however some taxiway and apron slopes are steeper than typical. The layout of taxiways and taxilanes is somewhat maze-like in the growth areas adjacent to the original business center in the northeast quadrant of the Airport.

The four FBOs each offer aircraft fuel for sale, requiring fuel storage facility access by delivery tanker trucks and aircraft fueling trucks. These facilities must meet FAA, EPA, State and local requirements for security, fuel quality, containment, spill plans, and fire codes.

Snow removal is a challenge in the winter. Each FBO is responsible for snow removal on its respective apron. The Airport removes snow from the maze of smaller taxilanes and aprons for the private hangars which requires a variety of equipment. In both cases, storage of removed snow often becomes an issue if snow accumulates. Airport representatives get involved with the management of accumulated/stored snow.

Operational Practices

Airport management leases out all development areas and only maintains the common areas such as runways and taxiways. The leases are let under Airport rules and regulations that require each lessee to configure, operate and maintain their apron(s) in compliance with guidelines contained within their lease. This is especially important for the four FBOs because of the large aprons with continuous aircraft and vehicle traffic. Each FBO is required to have an aircraft parking and traffic flow plan that is compatible with adjacent airport activity and access. Each FBO is also required to provide a minimum number of tie-downs based upon the leasehold. Each FBO has autonomy in ground handling, equipment staging, type of tie-down anchors, and control of apron access but must provide and maintain its own fuel storage facilities in accordance with applicable rules and codes. Apron pavements and markings must be maintained per the lease agreements. The airport establishes restrictions on vehicle traffic and aircraft parking in order to ensure security and protect required operational clearances.

Three of the four FBOs use cables for aircraft tie-downs instead of anchor tie-downs. The cables provide more flexibility for the mix of transient aircraft serviced by the FBOs but these cables present obstructions during snow removal. The four FBOs compete for business from transient aircraft, especially corporate jets. Part of this competition is reflected in the provision of “follow-me” vehicles along the inbound taxiways. The Airport has guidelines to keep this activity off of the active taxiways.

Each lessee must construct and maintain (at their cost) their aprons to the strength needed to support their operation. The only limitation is the overall airport pavement strength of the runways and taxiways. Currently the Airport receives flights from up to approximately 75,000 pound aircraft.

The Airport is responsible for the overall security of and access to the airside areas. The entire airport is enclosed within security and wildlife fences that are equipped with controlled automatic gates. Vehicles with regular authorized access display decals. Operators with preapproved access are issued coded gate access cards. The FBOs have control of the vehicle gates that provide access to their respective aprons.

The Airport includes a U.S. Customs and Border Protection facility to accommodate international arrivals. An apron area located approximately 300 feet from the U.S. Customs and Border Protection building is designated for processing and isolating international arriving aircraft.

Strengths

By placing the responsibility for apron activities on the individual lessee, the airport management has reduced their oversight of apron activities to manageable subdivisions. The role of airport management in controlling apron activity focuses primarily on keeping the leases relevant in light of evolving circumstances, working with the lessees to adhere to the lease agreements, and maintaining and enforcing airport safety and security requirements.

Other Information

The large FBO aprons are continually active with mixed fleet activity, but experience activity surges during mornings and evenings and peaks in business jet activity around special occasions such as conventions and important sporting events. The FBOs have developed apron layouts that allow for mixed use parking plans to accommodate surges and increased numbers of larger corporate jets. As an example, the jetCenter FBO has leased an overflow apron area adjacent to their main terminal that is normally used for small aircraft tie-downs but can be used for secondary storage for corporate jets. This FBO also purchased a former FBO not located on the main flight line and uses that facility for overflow aircraft parking and hangar storage. The X Jet FBO has recently expanded its apron to accommodate for more aircraft parking but, more importantly, to improve traffic flow during peak times. The TAC Air FBO has recently opened a self-fueling facility for small piston aircraft located at the corner of their apron leasehold, in an attempt to decrease truck fueling for small amounts of 100LL Avgas while concentrating personnel and equipment on fueling larger jets.

Figure C-5 Centennial Airport Self-service Fueling
Source: Ricondo & Associates, Inc., 2012; Google Earth Pro.

Small aircraft comprise a large percentage of the based aircraft at APA but do not fly as regularly as the corporate and business aircraft. The Airport leases areas that have been developed to provide small aircraft T-hangars and sunports. Integrating traffic with diverse physical and operational characteristics is a challenge on the ground. The Airport manages the use of taxilanes that serve business areas located adjacent to small-hangar areas. Painted setback lines (representing

object free areas) are used to keep taxilanes clear. All aircraft must obtain ground control clearance when departing hangar areas (non-movement areas) and entering the taxiway system (movement area). Larger aircraft do not use small-hangar taxilanes because of wingspan limitations and jet blast considerations/risks. This segregation of aircraft activity is a high priority for Airport staff.

A unique feature of the Airport is use of an aircraft gate, which provides controlled access to a taxilane and hangar with an adjacent apron. The gate is used to separate vehicular traffic from aircraft movements. When the aircraft gate is operated, crossing arms block traffic from crossing the taxilane to ensure the taxilane is free of vehicular traffic.

The Airport does not have a central deicing area. Instead, each FBO offers aircraft deicing within its leasehold. The FBO is responsible for containment of spent and runoff fluid and for any contamination problems that may result.

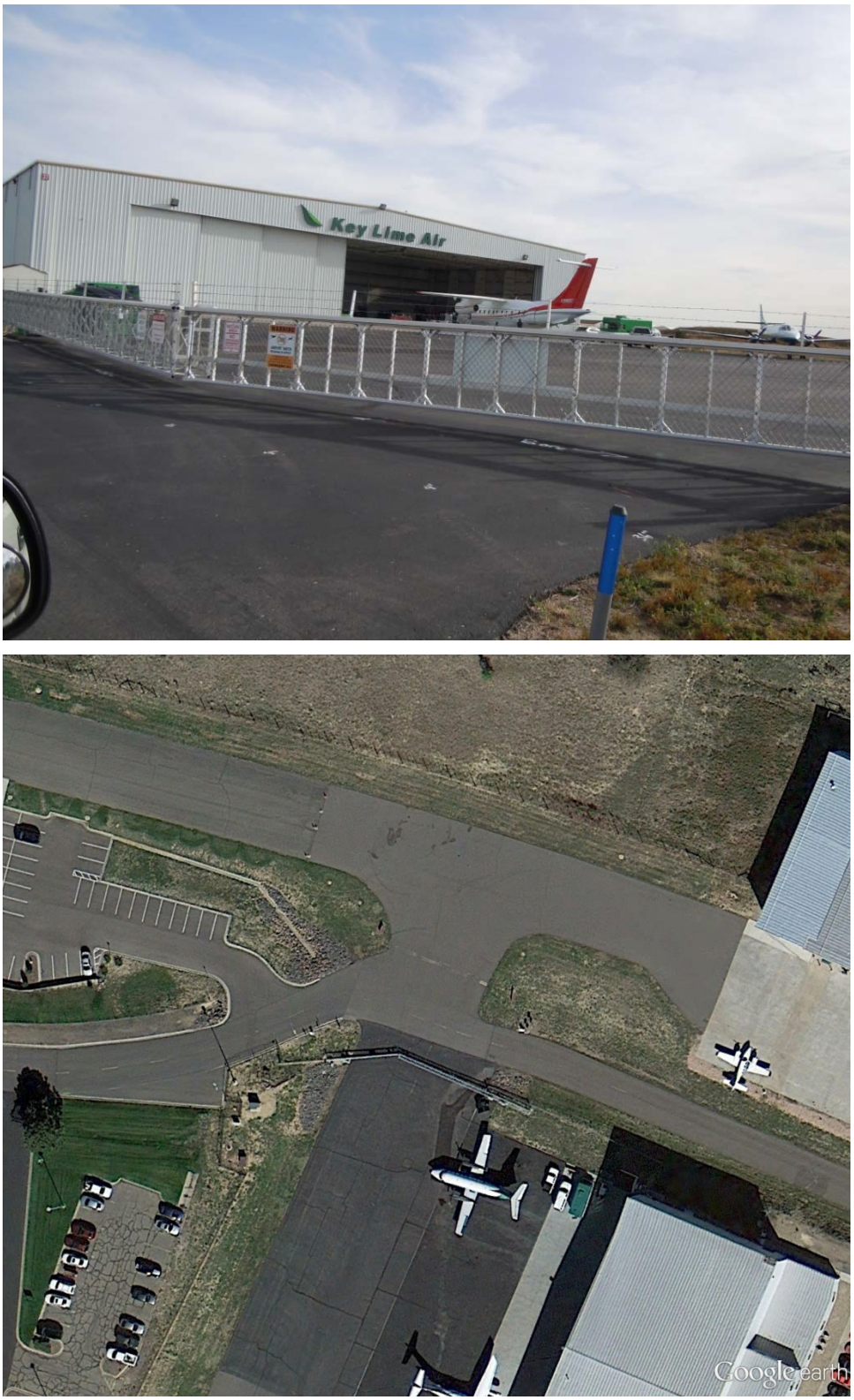

Figure C-6 Centennial Airport Aircraft Gate
Source: Airport Development Group, Inc., 2012; Google Earth Pro.

Helipad Apron

Figure C-7 Centennial Airport Aircraft Helipad
Source: Google Earth Pro.

Description

The Airport leases land to a tenant that operates a heliplex facility. The facility contains a landing and takeoff pad and six parking pads on the heliplex apron. Three additional landside and takeoff pads are located on a dead end taxilane. The adjacent hangar is used for storage and helicopter maintenance.

Operational Challenges / Physical Influences

There are few operational challenges with the heliplex since it is located away from the fixed wing aircraft aprons and hangars. Similar to fixed wing aircraft, helicopter movements are controlled by the airport traffic control tower.

Operational Practices

Facility is operated by the lessee.

Strengths

None

Other Information

None

CHARLES B. WHEELER DOWNTOWN AIRPORT (KANSAS CITY, MO)

Figure C-8 Charles B. Wheeler Downtown Airport
Source: Google Earth Pro.

General Aviation Apron

Description

Dedicated by Charles Lindbergh in 1927, Charles B. Wheeler Downtown Airport (the Airport) is the city's first airport and still one of its busiest with more than 65,000 annual aircraft operations ranging from single engine to corporate jets. The facility and its air traffic control tower are open 24 hours. Two fixed base operators (FBOs) service nearly 300 based aircraft, as well as itinerant and charter aircraft, offering fuel, full maintenance, aircraft rentals, sales and flight training. Future growth is severely constrained by the Missouri River on three sides and US Hwy 169 to the east.

The Airport does not have a designated helipad zone but allows multiple helicopter users to use leased and public apron areas for active operations through the airfield. Both FBOs have small

trucks to handle deicing situations but only Signature Flight Support (Signature) has a boom sprayer capable of deicing larger aircraft, up to a Boeing 737. Wheeler Airport does not have a designated cargo processing area.

Operational Challenges / Physical Influences

The airport is divided into two apron areas. The east side is served by Signature (Hangar 1) and the west side is served by Hangar10 and designated as the general aviation side of the airport. Also, the Airport's T-hangars and other box hangars are located on this side of the airfield. Signature occupies a facility that was once part of the original terminal when the Airport was the commercial service airport for Kansas City. The ramp in this area has a larger surface area and older pavement than the west side general aviation area. The majority of Signature's clients are large corporate charters (Boeing 727s or 737s), business jets, and occasional transient aircraft. Signature has the only stair truck on the airfield to assist with passenger loading. When appropriate, the FBO shares the equipment with Hangar10 as a professional courtesy.

On the west side general aviation area, the Airport and Hangar10 constructed new buildings approximately four years ago to service based and transient general aviation operations. Also, during this construction period new concrete aprons were poured on the west in a long parallel configuration to Taxiway Lima. Airport staff acknowledges the configuration is limiting for growth and creates movement conflicts with Hangar10 clients, but indicates that all players on that side of the field work cooperatively with the limited space. As noted in the aerial photograph, a white painted line separates the Airport's apron and Hangar10's leased apron space. When traffic volumes dictate, both entities allow cross-over parking and movement to ensure all operations are accommodated and safe.

When Kansas City hosted the 2012 Major League Baseball All Star Game, Taxiway Lima was converted into a temporary apron parking area to accommodate the large number of turbine aircraft. Also, the two annual NASCAR events at the nearby Kansas Speedway result in a significant number of operations with the aircraft mix slowly consolidating into larger charter operations (Boeing 727 and 737) where multiple race teams fly on a single aircraft. This consolidation creates space demands for the limited aprons on both sides of the airport.

Operational Practices

Wheeler Airport staff work with both FBOs to manage aircraft movements and operations but do not get involved with parking or handling aircraft. Airport staff availability is reduced after 4:00 p.m., so their ability to provide individual attention to parking and apron issues is limited at times. It is during periods when Airport staff is not available that the Airport relies on the FBO staff to professionally handle aircraft parking and movement issues with based aircraft and transient customers.

The Airport offers free parking on its six general aviation apron tie-downs in front of the west side terminal but it has conceded space to Hangar10 when overflow demands from its clients require more space. Hangar10 reciprocates when the Airport demands exceeds capacity. The city offers a 100LL self-serve fuel station on the west side near the T-hangar complex. Jet A fuel service is provided by the FBOs only.

Aircraft movements and safety can be impacted with multiple aircraft attempt to enter or exit the apron off Taxiway Lima through stub Taxiway Lima2. Egress from Lima1 and Lima3 create longer taxi times but could minimize movement congestion at Lima2 stub for aircraft wishing to access the GA terminal or Hangar10.

Strengths

Airport staff enjoys having concrete pavement on the general aviation apron areas given the benefit of reduced maintenance issues and longer life of the pavement. Many of the Airport's general aviation tenants prefer the concrete aprons versus the aprons constructed with asphalt.

Other Information

None

CLEVELAND HOPKINS INTERNATIONAL AIRPORT

Terminal Apron

Figure C-9 Cleveland Hopkins International Airport Terminal Apron
Source: Google Earth Pro.

Description

Cleveland Hopkins International Airport (CLE) is a medium-hub; commercial service airport located approximately nine miles southwest of downtown Cleveland. The Airport encompasses one passenger terminal with four concourses, A, B, C and D. The terminal complex is located on the east side of the airfield. Concourses A, B, C and D provide approximately 85 parking positions with access provided by both jet bridges and hardstands. Other support facilities include an air cargo service area, one fixed base operator, maintenance hangars and remain overnight parking.

Standard pavement markings are utilized in the terminal apron area. Airlines are responsible for markings at their respective leased gates. The Airport is responsible for pavement markings that link the airfield with the concourses. There are no taxiway/taxilane centerline markings within the non-movement area. There are zipper (service) roads supporting ground vehicle movements that

surround the terminal complex. A part of the zipper (service) road penetrates a portion of the movement area. The Cleveland Airport System has a letter agreement with FAA that allows the airport to operate the zipper (service) road within the movement area. There is no in-pavement lighting in the terminal complex. Lighting in the gate area is located on high mast poles next to the concourses, illuminating the respective apron areas.

The terminal complex is equipped with a hydrant fueling system support Concourses C and D. Fueling of aircraft parked at Concourses A and B is accomplished using tanker vehicles.

Operational Challenges / Physical Influences

There is limited ingress to and egress from the concourses from the airfield. Dual taxilanes support aircraft movements between Concourses C and D.

Depending in aircraft size, these taxilanes may be reduced to a single taxilane due to wingtip clearances.

Snow removal in the area between the concourses is a challenge due to a lack of space to stockpile plowed snow. Snow removed at the corners of Concourses of A and B, Concourse B and C, and between Concourses C and D has to be trucked out of terminal area.

It is anticipated that there will be a need for restrictions on the pushback of aircraft from the terminal due to the new Air traffic Control Tower.

Operational Practices

The Airport conducts monthly meetings with tenants to review critical items such as Foreign Object Debris (FOD), airport safety, and security issues. The Airport maintains a regular schedule for sweeping the terminal area pavement and other apron facilities to control the amount of FOD.

Strengths

Training programs are conducted with Airport Operations, tenants and other stakeholders. Tenants hold daily meetings to go over changes in operational procedures due to construction, weather, or other conditions that impact the way they would normally operate. Also, monthly meetings are held with Airport Operations, Airport Engineering, tenants and stakeholders to go over upcoming construction projects, operational changes and any safety concerns. The Airport collaborates monthly with all tenants to keep them informed of the status of airport improvement projects and other changes and activities at the airport. Airport Operations staff focus on the identification and resolution of issues/concerns before adverse consequences occur.

Other Information

None

Deicing Apron

Figure C-10 Cleveland Hopkins International Airport Deicing Apron
Source: Google Earth Pro.

Description

The Airport operates two aircraft deice facilities, referred to as PAD-1 and PAD-2, respectively. The two aircraft deice facilities are located on the east side of the airfield just south of the terminal complex.

PAD-1 consist of nine deice bays. The deice facility is designed to accommodate either six Airplane Design Group (ADG) III aircraft or three ADG IV aircraft. If needed, the deice bays can accommodate up to two aircraft per bay. The deice pad does not have a separate control facility as it is operated by Airport Ground Operations. The deicing of the aircraft is performed by a third party operator, AeroMAG. The PAD-1 deice pad is marked with several different pavement marking configurations to reflect the aircraft mix that may utilize the facility. Markings included centerline markings, non-movement area boundaries, position markings, and vehicle safety zone surface

markings. There is no in-pavement lighting to support ground movements, nor any overhead lighting to illuminate deicing operations.

PAD-2, consisting of a single aircraft by, is restricted to general aviation aircraft.

The PAD-2 deice pad is marked for a single aircraft deicing operation. Pavement markings include centerline markings, non-movement area boundaries, position markings, and vehicle safety zone surface markings.

Operational Challenges / Physical Influences

The pavement markings and signs identifying the PAD-1 deice facility are continually changed, reflecting the season. During the winter, the deice pad is designated to be in a non-movement area, whereas during the spring, summer and fall the deice pad is remarked and resigned as a movement area.

Operational Practices

Aircraft traffic accessing the deice pads is controlled by Airport Ground Operations, then turned over to a third party operator AeroMAG, for aircraft deicing and once complete, released to air traffic control (ATC) for taxiing to the departure runway.

Getting deicing equipment to and from the equipment staging area to the deice pad can sometimes be problematic. This is due to the service roads becoming impassable during snow events. Sometimes the deicing equipment have to use movement areas to get to and from the deice pad, typically 1 – 2 times per day.

Strengths

Regular safety meetings are convened, prioritizing safe practices and operations.

Safety audits are performed by airlines to identify opportunities for safety enhancements and to address any deficiencies identified. A matrix is used to measure efficiency and safety success of the deicing operations.

The location and design of deice pad allows for efficient traffic flow from the terminal complex and to the departure runways. Also with the dual configuration of the deice pad, it allows the airport to maximize the usage depending on the aircraft mix.

A glycol collection and containment system captures and recycles used deicing fluids, reducing the environmental impact of deicing operations.

Other Information

None

Cargo Apron

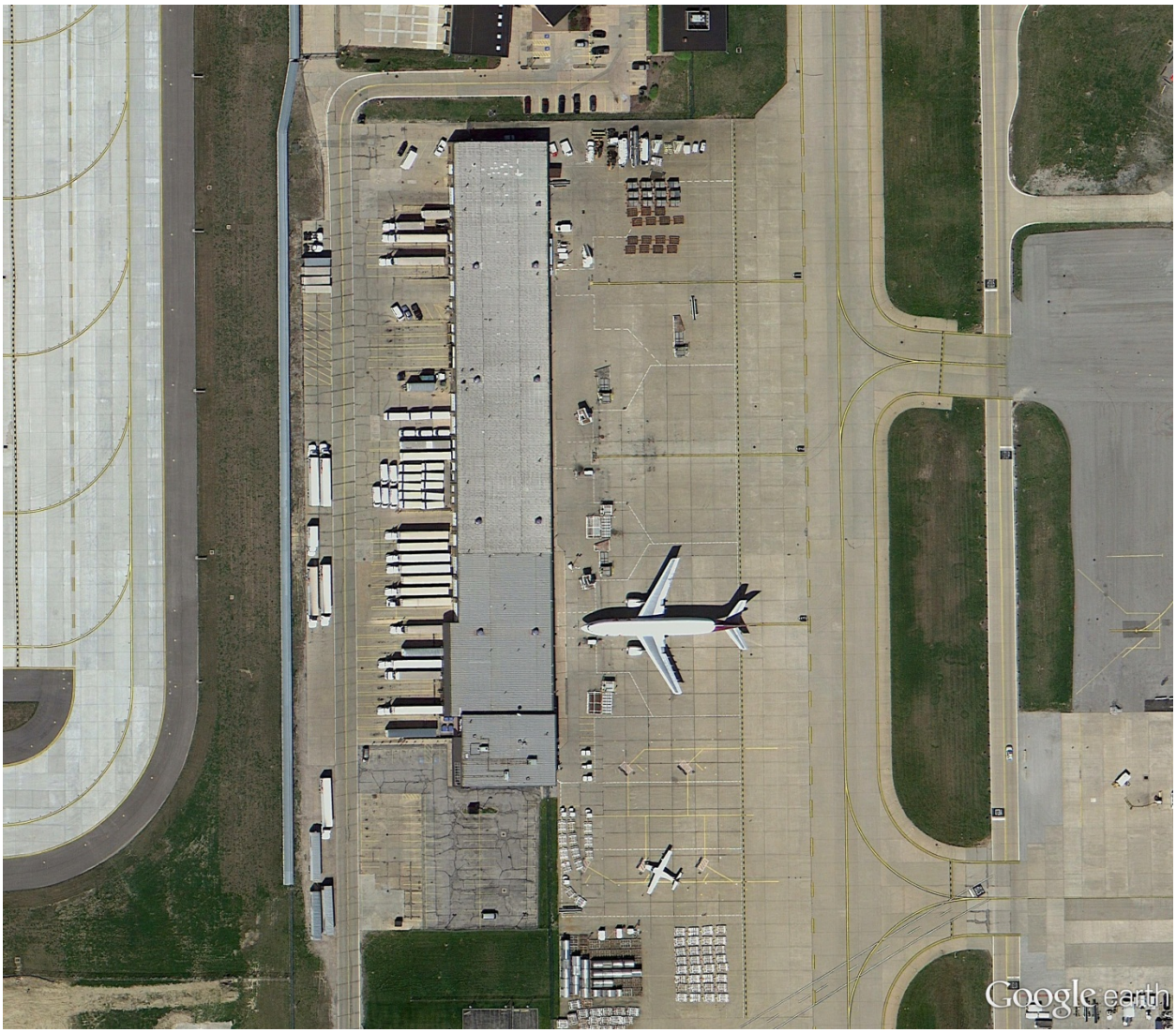

Figure C-11 Cleveland Hopkins International Airport Cargo Apron
Source: Google Earth Pro.

Description

The Airport operates two cargo facilities– Cargo/Freight Area and West Side Cargo Ramp. Both apron facilities are very old (approximately 30 years). Current cargo operators/tenants include FedEx, UPS, and the United States Postal Service. The Cargo/Freight area is located on the east side of the airfield directly south of the terminal complex. The FedEx portion of the Cargo/Freight Area has parking positions for three ADG III aircraft and five positions for turbo prop aircraft. The cargo apron has standard markings including lead-in lines, surface painted designations, aircraft envelopes, and parking envelope for GSE equipment. The West Side Cargo Apron is located to the west of the threshold of Runway 24R. The West Side Cargo Ramp has no markings except for a taxiway centerline leading into the apron. The West Side Cargo Ramp is illuminated by high mast lighting on south edge of the ramp.

Currently, the cargo operators deice at the cargo ramps rather than using the deice pads.

Operational Challenges / Physical Influences

Each of the cargo facilities has only one taxiway or taxilane access point, potentially causing congestion.

There is no dedicated space for the storage GSE equipment. GSE equipment is staged on the outer perimeter of the cargo aprons.

The cargo aprons are restricted in the size of aircraft that can operate at the facilities due to design and size of the aprons and clearances of taxiway/taxilane object free areas adjacent to the cargo aprons.

Each cargo facility is operated independently, resulting in inefficiency in the utilization of ramp space.

The airport doesn’t have a separate or airport owned facility capable of receiving aircraft with large cargo except for (FedEx & UPS).

Operational Practices

The existing cargo facilities and aprons are currently underutilized due to lack of cargo activity.

Strengths

The cargo facilities are located to allow access from the AOA (secure) and from the non-AOA (non-secure).

Other Information

None

Maintenance Apron

Figure C-12 Cleveland Hopkins International Airport Maintenance Apron
Source: Google Earth Pro.

Description

The Airport has two airline maintenance facilities, one operated by United Airlines and the other by Constant Aviation. These are located north of the terminal complex just south of Runway 28. The apron has no markings except for the non-movement area boundary and zipper (service) road. Any fueling at the maintenance facilities is done by tankers.

Operational Challenges / Physical Influences

The maintenance facilities are restricted in the size of aircraft that can access the facilities due to design and size of the aprons.

The maintenance aprons have only one taxiway or taxilane access point, potentially causing congestion.

The pavements around the maintenance aprons are beyond their useful life and require rehabilitation.

Operational Practices

Tenants operate the maintenance aprons based on demand. The aprons are fully under the control of the tenants in terms of aircraft movements, parking, and related activities.

Strengths

None

Other Information

None

General Aviation Apron

Description

The Airport has one general aviation (GA) facility, operated by Atlantic Aviation. Currently, two corporate aircraft are based at the GA facility. The facility is located south of the terminal complex just east of Runway 6R/24L.

The general aviation apron is marked with several aircraft lead-in lines at defined parking positions. Markings included centerline markings; non-movement area boundaries; aircraft parking position markings, and vehicle zipper road markings. There is not any in-pavement lighting to support aircraft ground movements. Aircraft fueling occurs on the GA apron with the use of fuel tankers.

Operational Challenges / Physical Influences

Currently there is only a single taxiway providing access to the GA apron, resulting in a one-way taxiway limitation. While not yet a limitation, pavement rehabilitation is planned due to pavement condition (low priority). Operational impacts would be expected during the construction operations.

There is a significant occurrence of FOD due to the pavement condition/deterioration.

There are not currently any operational challenges due to reduced usage/activity at the facility.

Operational Practices

None

Strengths

Excellent partnership and communication with GA operator (Atlantic Aviation) allows for quick response and resolution for issues that arise at the GA facility.

Other Information

None

DENVER INTERNATIONAL AIRPORT

Terminal Apron

Figure C-13 Denver International Airport Terminal Apron
Source: Google Earth Pro.

Description

The terminal apron at Denver International Airport (DIA or the Airport) consists of the aprons surrounding the three linear concourses (Concourses A, B, and C).

The three concourses each have different apron depths and thus can accommodate different sized aircraft. The south side of Concourse A has a 200-foot apron depth with a service road located between the concourse apron and apron taxiway, which also serves as the aircraft parking limit line. The apron on the north side of Concourse A has a depth of 291.5 feet. This depth includes a vehicle service road adjacent to the concourse building. An additional vehicle service road is provided at the outermost edge of the apron limit line. The north side of Concourse A accommodates international arrivals to DIA.

A vehicle service road is located at the perimeter of Concourse B, immediately adjacent to the building (inner service road). A supplemental vehicle service road is provided at the edge of the parking apron. The southern portion of the apron is approximately 307 feet deep, including the inner service road. The eastern end of the concourse separates into two finger piers, with the apron south of the facility at 170 feet deep and the apron north of the facility at 180 feet deep. The north apron depth adjacent to the concourse building has a depth of 275 feet (which includes the inner vehicle service road adjacent to the building).

The aprons located north and south of Concourse C have approximate depths of 250 feet. Service roads are located at the outer limit of the concourse apron on both the north and south sides.

Dual apron taxiways orientated parallel to the concourses are positioned south of Concourse A and between Concourses A and B, and B and C. A single taxiway provides access to the north side of Concourse C. The apron taxiways between Concourse A and B are able to accommodate B-747-400 and smaller aircraft. The apron taxiways between Concourses B and C are able to accommodate B-777 and smaller aircraft. A modification to standard allows for the taxiing of ADG VI aircraft on the southern taxiway between Concourse A and B with the adjacent taxiway restricted to aircraft with wingspans of 171 feet or less (ADG IV and smaller). In addition to the taxiways, taxilanes are provided at the aircraft parking limit line to provide access to concourse aprons and provide areas for aircraft pushbacks. The Purple Taxilane runs parallel to and north of Concourse A. Aircraft accessing the gates on Concourse B use two taxilanes oriented parallel to the concourse, which are referred to as Green Taxilanes. These taxilanes are able to accommodate B-767 and smaller aircraft. An Orange Taxilane south of Concourse C provides access to the aprons for B-757 or smaller aircraft. All of the apron taxiways are lighted with taxiway centerline lights. The taxilanes do not have centerline lights.

Operational Challenges / Physical Influences

Snow clearing and removal during the winter months presents a challenge to Airport Operations staff. Airlines are responsible for clearing their leased gate areas and pushing snow to the outer vehicle service roads. The Airport utilizes portable snow melters placed between Concourses A, B, and C and on the remote overnight pads located north and east of the concourses. This results in a portion of the main apron taxiways between the concourses being temporarily closed. As an alternative, aircraft travel on the colored taxilanes. If the wingspan of an aircraft exceeds the capability of the taxilane, a follow me truck is utilized to guide the aircraft to the gate. A portable lighted “X”s are placed in front of the portion of the taxiway that is closed. The Airport is exploring the possibility of rewiring the apron taxiway lights to enable a portion of the taxiway lights to be switched off while the melters are in use. Furthermore, the Airport is considering installing LED lights to match the color of the taxilanes. These two improvements would increase pilot awareness. Additional drainage was added to accommodate the runoff from the snow melters.

The overall increase in wingspans associated with new aircraft models and incorporation of wingtip devices (winglets) has introduced challenges on the terminal apron, including the loss of gates and infrequently requiring relocation of fuel pits. New aircraft models have introduced additional facility needs as well. For example, the Boeing 787 utilizes wireless internet to report maintenance and performance information to the airline owner. Additionally, the Boeing 787 has greater ground power requirements as compared to existing sized aircraft while parked at the gate. The need for additional equipment to accommodate future new generation aircraft is critical when planning aprons.

Operational Practices

Although the Airport plans each gate configuration and apron markings, each airline utilizes their own apron markings. The Airport includes markings on their terminal apron for passenger ground loading, fueling area restrictions (per the National Fire Protection Association regulations), and bus routes and stops. Also, the Airport has designated smoking areas for employees that are away from fueling activities.

The airport has installed storm sirens that warn apron workers when they need to evacuate the aprons due to lighting or strong thunderstorms. On the apron, the Airport has incorporated fire truck lanes into the apron markings to provide access and turnaround for each fire hydrant.

Strengths

With Airport management planning each gate configuration, they maintain control and ensure safety criteria are followed. This is especially important for adjacent gates assigned to different airlines.

Other Information

None

Cargo Apron

Figure C-14 Denver International Airport Cargo Apron
Source: Google Earth Pro.

Description

The cargo apron is located in the south airfield, west of Runway 35L at the end of Taxiways SC and A. The cargo apron encompasses approximately 54.6 acres. Major cargo companies that utilize the apron include UPS and FedEx.

Operational Challenges / Physical Influences

The cargo apron is considered a non-movement area and is controlled by the Airport ramp tower on Concourse A. Due to the distance and buildings between the cargo apron and the ramp tower, the apron is controlled through the use of several closed circuit television cameras.

Operational Practices

The major operators (UPS and FedEx) lease approximately two-thirds of the available apron. The Airport plans most stand parking using cargo operator standards. The Airport reviews the layout

but does not maintain liability for the parking of aircraft in these areas. Parking positions adjacent to other leaseholders are verified to ensure that the layouts provide for minimum wingtip separations according to FAA standards.

There are several parking positions that are used for transient aircraft or by cargo companies leasing only one or two parking positions. These positions are configured by the Airport.

For nose loading aircraft, such as the Boeing 747-400, the Airport maintains a nose to building separation that is sufficient to ensure the nose can open and vehicles can circulate in front of the aircraft.

Strengths

The cargo apron is configured with pavements areas utilized for the staging and storage of cargo loading equipment. This allows for full strength pavement to be utilized for aircraft parking.

Other Information

Very large aircraft, such as the Antonov An-124, cannot be accommodated on the cargo ramp due to its wingspan but rather are accommodated on a remote apron located east of the cargo apron.

Remote Apron

Figure C-15 Denver International Airport Remote Aprons
Source: Google Earth Pro.

Description

Overnight aircraft parking aprons are located north of Concourse C. The West DS Pad is able to accommodate 11 narrowbody aircraft up to a maximum B-737-900 with winglets. The East DS Pad is configured to accommodate up to 10 aircraft of various sizes. Additional overnight aircraft parking positions are located east of Concourse A.

Operational Challenges / Physical Influences

There are multiple needs for aircraft apron pavement. The overnight aprons were planned for multiple uses.

Operational Practices

The overnight aircraft parking aprons were planned and are used for several different purposes. Their primary function is to accommodate overnight parking of aircraft. During the

daytime when they are generally vacant, taxilanes present allow for use as “penalty box” for holding aircraft when departing aircraft are waiting for departure clearance and for arriving aircraft when a gate is not available. The West DS Pad can also be used for deicing aircraft since they are connected to a drainage system which is able to collect deicing fluid runoff. During snow removal operations, they are often used for snow piling and snow melting operations. Portable snow melters are placed on each apron where proper drains are located.

Strengths

The flexible layout of the aprons allows them to be used for multiple purposes.

Other Information

None

Deicing Apron

Figure C-16 Denver International Airport Deicing Aprons
Source: Google Earth Pro.

Description

Aircraft deicing is allowed on concourse aprons/gates when less than 25 gallons of deicing fluid is used in deicing an aircraft. Full aircraft deicing (use of more than 25 gallons of deicing fluid) occurs at specified deicing pads and approved aprons with industrial waste collection trench drains that provide for the collection of used deicing fluids for subsequent recycling. The most heavily used pads for full aircraft deicing are located west of the concourses.

The deicing pad adjacent to Concourse A is referred to as the A Pad and can accommodate up to five narrowbody aircraft or a combination of one widebody aircraft and three narrowbody aircraft. The A Pad previously utilized fixed deicing lifts and sprayers which were removed within the last few months.

The deicing pad adjacent to Concourse B is referred to as the B Pad, which can accommodate up to six narrowbody aircraft or three widebody aircraft. Two deicing pads are located west of

Concourse C. The westernmost pad is referred to as the C Pad, which can accommodate five narrowbody aircraft or three widebody aircraft. The J Pad is located between Taxiway J and Concourse C and is sized to accommodate six narrrowbody aircraft or three widebody aircraft. The WA Pad is located at the intersection of Taxiways WA and B4 and can accommodate six narrowbody aircraft or three widebody aircraft. All five deicing pads located adjacent to the terminal/concourse complex have spent fluid/runoff storage tanks that are connected to a glycol recycling facility.

Operational Challenges / Physical Influences

During deicing operations, the Airport typically operates in a north flow (departures to the north on the west side runways and arrivals to the north on the east side runways). The locations of the deicing pads support this operation. Full deicing operations can also occur on deicing pads located in the north and south airfields that are equipped with drainage and glycol recycling storage facilities. These aprons are infrequently used because of the logistical challenges of providing deicing equipment and personnel to these locations, particularly when the majority of aircraft deicing activity is accommodated on other pads. Additionally, because the deicing fluid collection tanks at these facilities are not connected to the deicing recycling facility located west of the deicing pads, transportation of the collected fluid/runoff is more challenging at these locations.

Deicing of aircraft is conducted by a contractor or by individual airlines. The deicing positions on each pad are assigned prior to the beginning of the deicing season in accordance with anticipated flight schedules. The Airport has contemplated use of a single common deicing provider in order to allow for greater utilization of the deicing pads by instituting first in, first out queuing. Additionally, under this scenario the Airport would have the ability to assign aircraft to a pad based on their departure runway, which would result in more efficient taxi movements.

In addition to the designated pads, deicing operations occur on the south cargo apron and the general aviation ramp. Both of these ramps are equipped with detention facilities that store deicing fluid runoff for eventual discharge to a wastewater treatment facility. If capacity is sufficient, the ponds detain the runoff to allow for water evaporation to concentrate the deicing fluid. The fluid is either transported to the deicing fluid recycling facility or released to the local wastewater treatment facility.

Operational Practices

Placement of deicing pads must consider the movement of equipment between facilities while balancing the closure of vehicle service roads during low visibility conditions. The main service roadway on the west side of the concourses is typically closed during deicing operations in order to reduce vehicular traffic near the pads. Deicing equipment and deicing fluid is stored in areas adjacent to and east of the pads. Each of these areas contains a deicing coordination building, areas for filling deicing vehicle fluid tanks and vehicle storage areas.

The Airport has begun using Aerobahn software, a surface management system that assists with the controlling of aircraft movements and the assigning aircraft to deicing pads.

Strengths

The deicing pads allow for collection of spent deicing fluid which is recycled on-site and reused for other commercial and industrial purposes.

Other Information

Typically winds are from the north during snow conditions. The pads are marked with alternate parking positions in order to more easily apply aircraft deicing fluid during strong wind conditions.

DETROIT METROPOLITAN WAYNE COUNTY AIRPORT

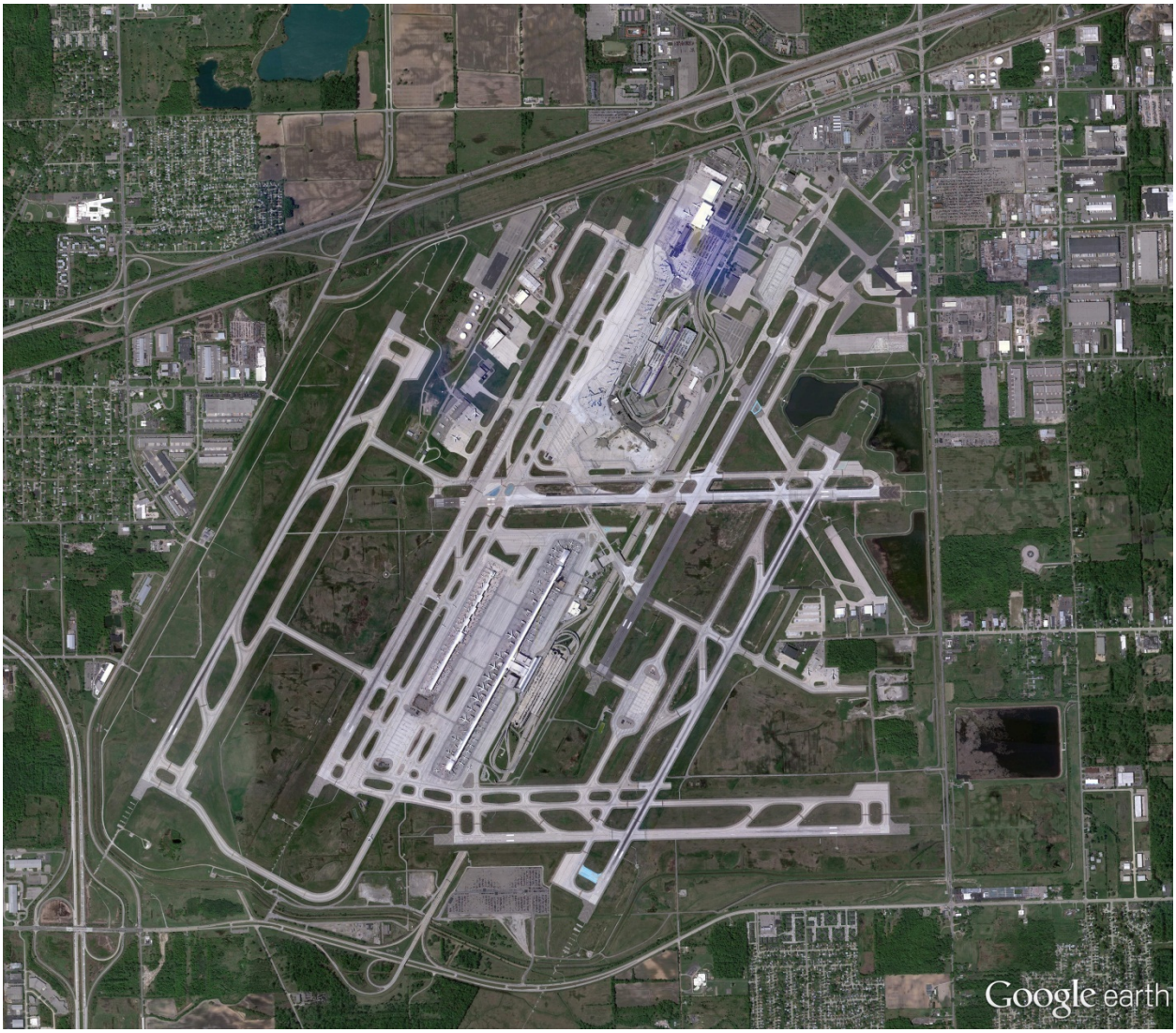

Figure C-17 Detroit Metropolitan Wayne County Airport Aerial Image
Source: Google Earth Pro.

Terminal Apron

Description

Detroit Metropolitan Wayne County Airport (DTW or the Airport) is a large hub, commercial airport, located 22 miles southwest of downtown Detroit. The airport consists of two passenger terminals with a total of 145 contact gates (ADG III through ADG V). Other services and facilities at DTW include, cargo, a ground run up enclosure, remote deicing facilities with approximately 26 aircraft positions, remain overnight (RON) parking, two Fixed Base Operators, and aircraft maintenance services.

Operational Challenges / Physical Influences

A wide variety of aircraft operate at the airport ranging from small general aviation aircraft to large commercial aircraft. To keep operations on the airport running smoothly, the airport is

typically operated in a north/south pattern with departures on the inboard runways and arrivals on the outboard runways during peak departure/arrival banks to limit delays and accommodate tight connecting schedules. Operational challenges that face the Airport include:

Required coordination of substantial Ground Service Equipment (GSE) traffic with aircraft movements

Accommodation of RON aircraft parking when the demand for contact gates exceeds the total number available

Insufficient space west of Concourses to B and C to meet taxiway object free area (TOFA) requirements for ADG-V aircraft

Coordination between tenants and required gate closures during construction/maintenance periods

Operational Practices

The Airport promotes communication between the Airport Authority and all stakeholders. Bi-weekly airfield coordination meetings are held with all stakeholders to maintain communication and keep all parties apprised of upcoming activities including construction projects and to allow stakeholders to participate during planning for appropriate events and activities. The apron around each of the gates is leased to the individual airline that leases the gate. Each airline is responsible for maintaining the leased apron area, including ramp markings, positioning of GSE equipment, and passenger loading bridges. The Airport is responsible for the maintenance of the pavements and snow removal around the terminals. Both terminals have an in-ground hydrant fueling systems that are operated by ServiceAir.

Strengths

The linear configuration of all contact gates allows maximum flexibility for multiple users/aircraft types. In addition, a continuous vehicle service road at the aircraft parking limit line at all contact position allows efficient movement for GSE.

Other Information

The Airport maintains several RON positions for aircraft parking around the old terminal buildings. These positions vary in size, accommodating aircraft ranging from ADG-III to ADG-V. The markings of these RON positions also differ, with some just including nose wheel centerlines and other including aircraft service envelopes and GSE equipment layouts.

Deicing Apron

Description

The Airport operates four remote deicing aprons located adjacent to ends of each primary departure runway, with approximately 26 total aircraft positions among the four aprons.

Operational Challenges / Physical Influences

The configuration of the deicing aprons can limit the efficiency of the operation depending on the size of aircraft using the apron. Depending on the deicing apron, wide body aircraft may be able to occupy two spots. Each of the four deicing aprons has its own control tower to monitor and control the deicing operations. The locations also have areas for staging of deicing equipment and above ground tanks for the storage of deicing chemicals.

Operational Practices

Movement of aircraft to and from the deicing aprons is handled by the air traffic control tower (ATCT). Once the aircraft reach their designated deicing apron, ATCT passes control of the aircraft to the ramp control tower associated with the respective deicing pad. Deicing of aircraft is provided by the airline operating the aircraft or through a third party contractor, Integrated Deicing Services (IDS). The Airport maintains the apron pavement and is responsible for snow removal at each of the aprons.

Strengths

The location of the deicing aprons in relation to the primary departure runways allows for a short taxi after completing the deicing process, increasing the likelihood of meeting the holdover time requirements to allow departure.

Other Information

Each of the deicing aprons has a collection system for the spent and runoff deicing chemicals. The collected fluid is then disposed of separately from storm water runoff.

Cargo Apron

Description

At DTW, the Airport operates two primary cargo ramps, FedEx (4 positions) and UPS (2 positions). Each cargo facility has a building on-site that houses a sort facility.

Operational Challenges / Physical Influences

The location and hours of operation of the cargo facilities on the airport present few operational challenges. The FedEx cargo facility is located just west of Runway 4R/22L, off of Taxiway Zulu, and the UPS cargo facility is located east of Runway 3R/21L, off of Taxiway F. These locations result in the cargo operations being separated from the majority of commercial traffic at the Airport.

Operational Practices

Each cargo facility is operated by the tenant, with each tenant being responsible for the maintenance of and snow removal in the ramp area.

Strengths

The physical and operational separation of the passenger and cargo aprons supports a more homogeneous operating environment in each of the two apron areas. Additionally, the reliance on ramp control towers to manage and operate the deicing pads promotes a more efficient operating environment.

Other Information

There are also several aprons and hangar facilities that the Airport leases as needed to airlines for use as cargo aprons. These aprons are maintained by the Airport.

DOWNTOWN FORT LAUDERDALE HELIPORT

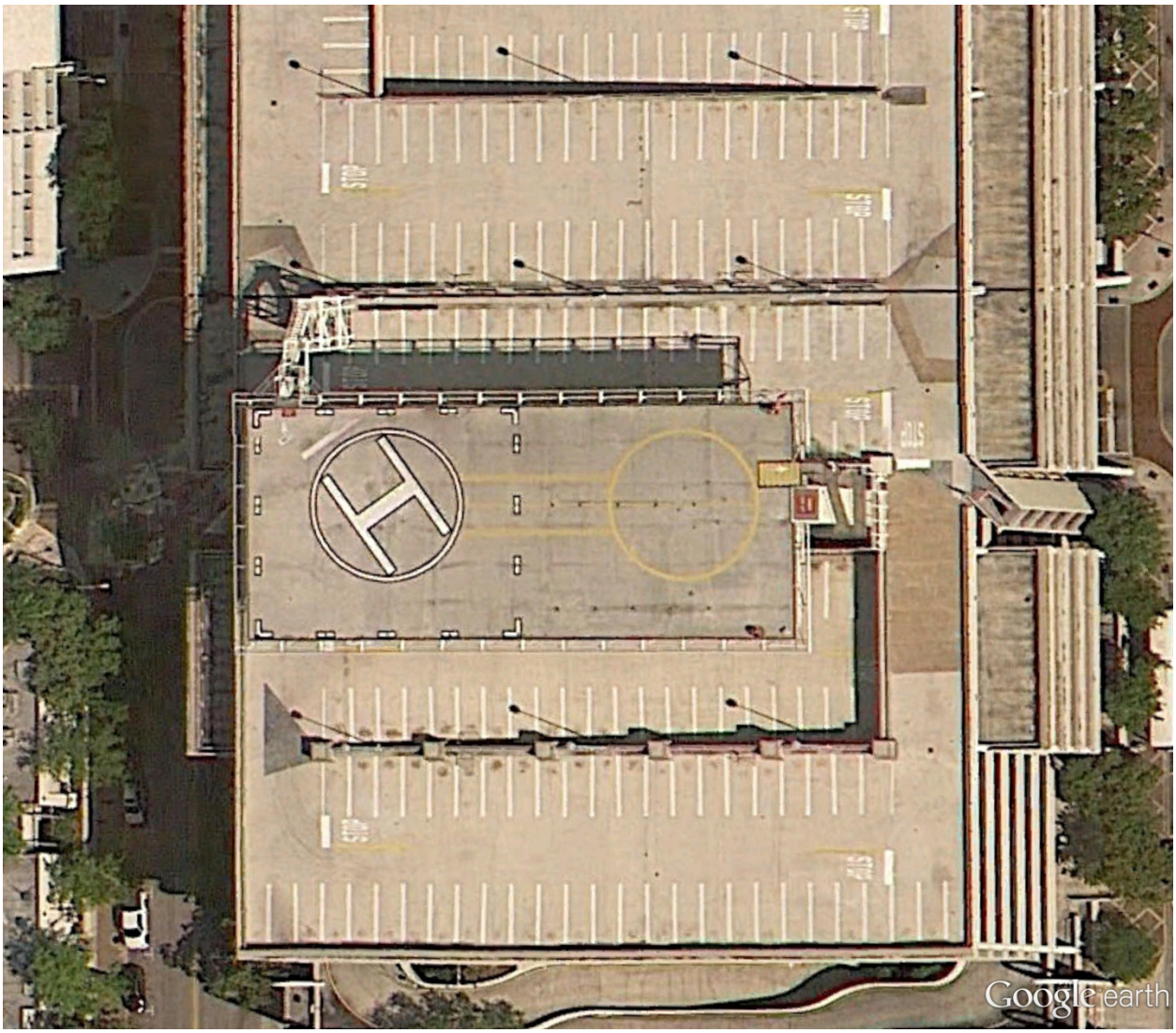

Figure C-18 Downtown Fort Lauderdale Heliport Aerial Image
Source: Google Earth Pro.

Heliport Apron

Description

The Downtown Fort Lauderdale Heliport is a standalone general aviation helicopter landing facility located in downtown metropolitan Fort Lauderdale, Florida. The facility is situated atop a city-owned parking garage at an elevation of 113.5 feet above mean sea level (MSL). More specifically the facility is located at 26° 7´ 13.672" N and 80° 8´ 31.398" W. The heliport was designed to accommodate a Bell B-412 Helicopter with one helicopter parking area and one hot landing area. The landing area has two approach/departure surfaces. The primary surface is oriented at 145°/325° and the secondary surface is oriented at 047°/227°. The heliport has standard heliport markings. Lighting consists of medium intensity perimeter lighting.

Operational Challenges / Physical Influences

The heliport is a public use landing facility with no scheduled airline service or tenants. Use of the heliport is on a “first come first serve basis”. However, with the heliport being located in a metropolitan area the biggest operational challenge is the potential for future development to create obstructions to air navigation depending on building locations, heights, and other characteristics.

Also, with the heliport being located on top of a parking garage, additional challenges include:

- Landing weight restrictions (limited by structural capacity of the parking facility)
- Limited operating surface area (approximately 180.7 feet by 94.3 feet).

Operational Practices

The landing facility is unstaffed and as such airspace is controlled by Ft. Lauderdale International Airport’s (FLL) Air Traffic Control Tower. Due to the limited operating surface the facility is restricted to one landing area and one parking area. After receiving clearance, approaching helicopters must land on the landing surface, drop-off/pick-up its passengers, and then immediately depart. If a helicopter is already occupying the parking area and another helicopter approaches the landing area, the approaching helicopter is not permitted to touchdown. Helicopters are not permitted to land on the parking area.

Strengths

The heliport’s location is its biggest strength. With the heliport being elevated on top of a parking structure pilots are permitted to operate without ground interference from local traffic and pedestrians. Existing building setbacks also create an area to land free of obstructions.

Other Information

Other apron elements that perform well in supporting safe and efficient operations include the following:

- Safety fencing secured to the perimeter of the facility provides fall protection for the public.
- A fire suppression system is installed.
- A flush landing elevator provides access to the helicopter apron for disabled users.

GENERAL MITCHELL INTERNATIONAL AIRPORT

Figure C-19 General Mitchell International Airport Aerial Image
Source: Google Earth Pro.

Terminal Apron

Description

Milwaukee General Mitchell International Airport (MKE) is a medium hub, commercial airport located 6 miles south of downtown Milwaukee. The terminal consists of three concourses (C, D, and E) encompassing a total of 42 airline gates including one international gate, serving eight air carriers. The terminal apron is approximately 65 acres. The airport is primarily designed for Aircraft Design Group (ADG) III. There are no taxilane centerlines leading into concourse alleys, only lead-in lines to each of the gates. The terminal apron has a vehicle service road (VSR) along the non-movement area boundary that is marked as a "zipper road" although it is located in the non-movement area. The terminal apron has seven identified remain overnight (RON) parking locations to accommodate Boeing 717 and 737-800 aircraft marked with "T" nose wheel parking locations. MKE has standard markings for their terminal apron, including lead-in lines, surface painted gate

designations and aircraft envelopes. Lighting in the gate area is on masts located next to the concourses, illuminating the respective apron areas. Fueling for the terminal complex is provided by a hydrant fueling system.

Operational Challenges / Physical Influences

The Airport faces several operational challenges that are influenced by the apron configuration. These include:

- Aircraft deicing activities occur at the gate as well as at remote aprons. Deicing chemicals are recovered using Glycol Recovery Vehicles (GRVs), which increases the number of vehicles in the operating environment during deicing conditions.
- There are no centerlines leading in to or out of the gates between the concourses inside the non-movement area.
- Air carriers oftentimes block alleyways when pushing out of concourses.
- Snow removal operations present challenges in finding stockpile sites. The Airport is analyzing the feasibility of utilizing snow melting machines to reduce the stockpiling requirements.
- The airport and terminal were designed several decades ago and evolving aircraft fleets and operational practices are more challenging in an older facility.

Operational Practices

The terminal apron only has two widebody aircraft gates. Operationally, aircraft generally power into and push out of the terminal gates. Previously, the airport had evaluated placing centerlines in-between the concourses; however, decided against using them as operators oftentimes assume if lead-in lines are present that there is a wingtip clearance guarantee and that is not always the case.

The airlines handle the pushbacks unless it impacts the taxiways and then clearance must be given by the tower. Taxiway B object free area (OFA) is adjacent to a few gates where aircraft push back into the OFA. To minimize calls to ATC, signs have been added to each gate stating whether or not clearance from ATC is required. Airlines remove snow near the gates and push the snow to a common area where airport staff removal from that location. They typically try to place as much of the material in the islands without impacting wingtip clearances and OFA's. They also have two snow storage locations north of the terminal facilities.

Strengths

Additional apron space beyond that in the terminal core is available that can be used for aircraft deicing activities, which ultimately frees up terminal apron space, reducing gate occupancy time and allowing for less constrained snow removal activities.

Other Information

The Airport collaborates with the terminal operators to define clear lines of operating procedures and review of aircraft parking layouts. Currently there is no ramp tower at MKE. They did have one initiated by the air carriers, but there was a lack of trust between the different carriers and it was decided to not continue its operation.

Cargo Apron

Description

The cargo apron at MKE is approximately 22 acres and is located on the west side of the airfield near the approach end of Runway 7R. Currently, the cargo apron accommodates the

activities of two cargo operators, UPS and FedEx. Previously, air carriers occupied the two additional hangars adjacent to the cargo facilities; however, those hangar spaces are currently vacant. The cargo apron accommodates a range of aircraft types including the Boeing 747 during peak operating seasons. Adjacent pavement is used as a deicing facility when necessary. The cargo aprons have standard markings including lead-in lines, surface painted gate designations and aircraft envelopes. Lighting in the cargo area is on masts located next to the cargo facilities. Fueling for the cargo aprons is provided by trucks.

Operational Challenges / Physical Influences

The Airport faces several operational challenges that are influenced by the cargo apron configuration. These include:

- The location of the cargo apron relative to the Runway 7R approach can result in penetrations of the runway's Part 77 surface (particularly in instances when operator's position disabled aircraft to allow the operation of replacement cargo aircraft.
- The proximity of a dual-use facility (i.e. cargo and air carrier maintenance hangars) can result in operational conflicts.
- When deicing activities are active on the cargo apron or adjacent pavement; keeping both operations operating smoothly can presents challenges.
- Geometry of access taxiways including Taxiway A4.

Operational Practices

Close coordination is needed when aircraft deicing activities are occurring on the cargo apron or adjacent pavement to allow continuous operations of both activities.

The Airlines handle the pushbacks unless it impacts the taxiways and then clearance must be given by the tower.

Strengths

The cargo apron is available for use as a remote deicing pad and is in close proximity to the Runway 7R threshold, which frees up terminal apron space. This provides two significant benefits; first, it provides more time for snow removal activities around the airline gates; secondly, it reduces gate occupancy time.

Other Information

The Airport has a project underway to pave the unpaved infield areas adjacent to the cargo apron to increase deicing capabilities by creating additional deicing positions. This will allow more aircraft to be deiced away from the terminal core area.

MEMPHIS INTERNATIONAL AIRPORT

Terminal Apron

Figure C-20 Memphis International Airport Terminal Apron
Source: DigitalGlobe, 2013; Google Earth Pro.

Description

The Memphis International Airport (MEM or the Airport) is located approximately 7 miles Southeast of Downtown Memphis and serves as a commercial and cargo hub. It is currently the second busiest cargo airport in the world measured by weight/cargo volume. The airport has four runways and with the "World Runway" has the ability to handle even the largest aircraft. The existing terminal apron, serving 83 commercial aircraft gates, is currently under construction. An exterior access road around the apron provides for efficient traffic access. Other services and facilities at MEM include two Fixed Base Operators, aircraft maintenance services, and an Air National Guard Base.

Operational Challenges / Physical Influences

With multiple major commercial airlines serving the Airport, there are approximately 150 daily commercial flights per day. Cargo operations, primarily by FedEx, consist of approximately 260 or more daily flights (Monday-Saturday). With the aircraft using the three parallel runways daily, access to the runways and terminal apron are maintained with multiple access points.

Three primary operational challenges with the terminal apron include the following:

Routing of aircraft to accommodate maintenance and rehabilitation of adjacent taxiway - With aircraft operations occurring both day and night, available time periods to accommodate pavement maintenance and rehabilitation needs adjacent to the apron are limited. With the design of the terminal apron, the multiple apron access points are useful for allowing efficient access with properly phased construction projects.

GSE traffic on the ramp - During aircraft operations, GSE will access the apron for multiple reasons. The combination of GSE equipment and aircraft operating in the apron area create potential hazards. The Airport continually stresses to tenants to be aware of traffic (vehicular and aircraft) while operating.

Limiting access (for GSE and aircraft traffic) on the ramp while a project is under construction - While the terminal apron will be reconstructed between 2012-2014, maintaining access for the GSE and construction equipment posed a challenge. To limit the potential for confusion, access points for the GSE and construction equipment were separated and the project design defined specific haul routes for the construction vehicles.

Operational Practices

The Airport goes to great lengths to keep stakeholders up to date and involved in the construction planning process. Methods to accomplish this include the following:

Communicating plans to stakeholders - Airport Development staff holds a weekly meeting with stakeholders to provide updates on progress of construction projects and future plans. At this meeting, an update on each active construction project is provided with a look ahead discussed to identify any potential impacts to the stakeholders operations. During this time, closures of active airfield pavements are discussed and a time period for each closure is agreed upon. The Airport Operations representative present in the meeting works with the Airport's Project Manager to get NOTAMs for the closures filed in a timely manner.

Maintain positive and open relationships with tenants regarding potential and current projects and devise plans to minimize effects on their operations - By maintaining positive relationships with stakeholders, the Airport is able to provide multiple avenues for potential impacts to the stakeholders' operations to be defined and analyzed in a timely manner.

During construction or maintenance activities strive to affect the least number of gates as possible – Minimizing impacts to the Airport's operations is critical. . For the current terminal apron project, multiple gate relocation plans were created and used to define the project phasing limits. The primary goal was to provide minimal impacts to the gates. Gate relocations can have a significant impact on stakeholders if their equipment and operational needs have to relocate to an open gate.

Strengths

The airport staff takes precautions to promote safety on the terminal apron. By continually focusing on communication with their stakeholders, the airport is able to keep safety as a primary thought. Methods to promote safety include the following.

- The main access road is located on the exterior of the ramp.
- Restrict GSE traffic from crossing the aprons unless absolutely needed.
- Provide multiple access points from the apron to the taxiways, maximizing operational efficiency during peaks in aircraft schedules.

Other Information

Other methods related to operating vehicles on the apron include the following.

- Training for Class 2 and 3 drivers is well organized with frequent retesting procedures are in place.
- Staff from Operations and Police Safety is very visible and continually looking for potential issues.
- Construction teams are required to assist in picking up FOD. Example is a sweeper at each active pavement crossing that follows all traffic crossing the open pavements. Backup sweepers must be onsite in case one breaks down or has maintenance issues.
- Shared traffic lanes.

Cargo Apron

Figure C-21 Memphis International Airport Cargo Apron
Source: DigitalGlobe, 2013; Google Earth Pro.

Description

The cargo operations at MEM include facilities in three separate locations. The largest cargo operation is the worldwide hub for FedEx. FedEx operates approximately 260 flights a day. Additional cargo facilities include UPS's and an additional apron available for alternate cargo operators that need use of an apron and facility for operation.

Operational Challenges / Physical Influences

With the locations of the cargo facilities near the perimeter of the airport, using the runways and taxiways nearer the perimeter of the airfield help to reduce the amount of cargo traffic operating adjacent to the terminal apron used for commercial aircraft. An operating challenge is operating during the daytime along with other airlines and having the ability to have aircraft departing in a timely manner. Cargo operations are largely impacted by time and delays can have a negative effect on the on time delivery of the cargo. The control tower has specific taxi-routes that the FedEx

aircraft use when departing and arriving. During nighttime operations, the commercial airlines are not typically operating and a drastic reduction of coordination required. Cargo operators participate in the weekly construction coordination meeting held by the Airport. All tenants, Fire, Law Enforcement, FAA, and the Airport Authority are represented at this meeting, which is focused on ensuring that there are no unexpected construction-related events, conditions, activities, or operations related to construction and safety concerns.

Operational Practices

The land occupied by cargo facilities is owned by the Airport and leased to the tenants. Each tenant is responsible for the operation and maintenance of the leased apron. FedEx has a ramp tower for their apron operations and use computer software to assign taxi routes and parking locations of aircraft well in advance of arrival and departure. Scheduling to the minute allows for the efficient use of access points by the aircraft and GSE equipment for each ramp.

FedEx holds an internal coordination meeting once a month to discuss operational and maintenance issues. This could include discussion on closing of apron pavements, gates, taxiways, or the need to redirect aircraft for a period of time. At this meeting each group is represented and has the decision-making authority of each group's Vice President to allow for a real time decision to be made at the meeting. The maintenance and operational groups hold a meeting weekly to discuss ramp issues and needs that need to be addressed.

FedEx conducts regular inspections of their apron pavements and is responsible for all maintenance activities (repair of pavement failures, joints repair, etc.) and new pavement constructed in the leased cargo area. The airline has a continuous pavement maintenance plan that evaluates the apron pavements with a focus on a 1-year and 3-year planning periods. FedEx also has a pavement management plan (10-year) that looks at long term needs for future pavements and emerging maintenance issues. The age of the existing pavements, testing results from pavement cores, and the documented history of pavement failures are all part of this management plan.

Ramp operations are affected by construction activities. The areas affected by construction typically result in reduced gate availability. FedEx utilizes permanent and temporary parking positions. The airline does not have a standard type of loading/unloading equipment that will work for each aircraft. Depending on gate availability, weather, and size of aircraft, the airline occasionally sends aircraft to other hubs to be off-loaded and reloaded. Their monthly meetings help the airline limit the number of aircraft to be diverted to a different hub.

Strengths

The location of the cargo aprons, isolated to the perimeter of the airfield, in relation to the terminal minimizes impacts to commercial operations. FedEx's apron design accommodates the flow of aircraft and ground equipment in the apron area. Up to 3,700 pieces of drivable ground equipment is used nightly. This number does not include non-motorized equipment (e.g., trailers) that are pulled around the apron. The airline emphasizes the critical need to keep ground equipment within the marked driving lanes to protect the safety of their personnel and equipment.

FedEx has devised a method to eliminate the use of tail stands that were used to protect against aircraft becoming tail heavy during the loading/unloading process. Previously, the airline put a stand under the tail to keep the nose of the aircraft from elevating while cargo is being placed in the aircraft. FedEx now uses tethers that are connected to the nose wheel and are anchored to a structure 30 feet below ground. This change has reduced the amount of equipment needed nightly and enhanced the safety environment for their personnel and their aircraft.

FedEx uses a complete coverage lightning elimination system, which protects equipment and personnel from lightning strikes and has increased the safety of their personnel. This system has been in place since 1997 and continues to perform in a satisfactory manner. In order to further reduce the amount of equipment required in the apron area, FedEx will be converting to a complete hydrant fueling system within the next five years.

FedEx has provided in pavement lighting for aircraft traffic lanes that meet the SMGCS requirements detailed in FAA advisory circulars.

Other Information

Another item that FedEx considers integral to successful operations is adequate apron storm water drainage. While controlling runoff during a rain event, it is also critical for controlling runoff during deicing operations. FedEx is working to dynamically manage existing drainage patterns to control chemical runoff from deicing operations.

OGDEN-HINCKLEY AIRPORT

Terminal Apron

Figure C-22 Ogden Hinckley Airport Terminal/General Aviation Apron
Source: Google Earth Pro.

Description

Ogden-Hinckley Airport (the Airport) has been in use for decades as a weather reliever for Salt Lake City International Airport. The primary runway and parallel taxiway is rated at 95,000 pounds double wheel gear (DWG), which limits operations to narrowbody aircraft. The terminal apron is similarly rated, as is the deicing pad, but all other pavements are intended for general aviation aircraft in the range of Airplane Design Group (ADG) A-I to B-II. Due to the limited size of the apron, only one narrowbody aircraft can be parked at a time. Prior to initiation of commercial service at the Airport, the size of an aircraft was of little importance, since diverted airliners would be parked on the parallel taxiway until allowed to depart to Salt Lake City International Airport.

The commencement of commercial airline service in September 2012 has become a hindrance due to the size and immediate proximity of the commercial apron to general aviation

traffic and lower strength pavement. The Airport was able to prepare the apron for commercial airline service in six months.

The terminal apron is chevron shaped, conforming to the layout typical of the 1940s for airports with multiple runways oriented in different directions. It is constructed largely of concrete with a recent expansion constructed in asphalt. One half is being used to support the aforementioned commercial operations (currently McDonnell Douglas MD-83 operated by Allegiant Air) and the other half of the apron is used by an adjacent Fixed Base Operator (FBO). On the north (commercial) side, a portion of the adjacent general aviation ramp was reconstructed to ease taxi operations. Even with this reconstruction, the facility is minimally sized for its purpose. The airport intends to use this apron on a temporary basis until activity dictates construction of a new commercial terminal, proposed for the northwest side of the airport.

Operational Challenges / Physical Influences

The limited size and the airports operational pattern have made this a one-way apron. Operationally, the airport uses the main runway in a north arrival, south departure mode for large aircraft and instrument operations. That allowed the ramp to be expanded on the north side of the parking area and eliminate tight turns that would have been required to park the airliner on the north portion of the ramp. The deicing pad is ahead of the parking area and accessible via full strength pavement. From the deicing pad and from the parking apron, aircraft can readily access the parallel taxiway, although the radii are smaller than desirable. Due to its small size, the apron requires careful entrance and exit maneuvers by aircraft. Guidance striping has been provided to assist pilots as they enter and exit the taxiway and the adjacent deicing pad.

Operational Practices

Separation of passengers and ground service equipment (GSE) was a concern during layout of the apron for commercial service. North, south, and east facing parking plans were created and analyzed to show how ground activities could be arranged. The south facing plan was accepted because of the arrival from the north and because the deicing pad was located to the south, simplifying aircraft movements. The airport constructed a new terminal building immediately adjacent to the edge of the apron and outbound passengers exit the building just north of the middle, traveling south along the east fence until turning west to the aircraft boarding ramp. Inbound passengers come to the fence and turn south to the existing building entrance and the terminal lobby. GSE and baggage carts are used on the west side of the aircraft, entering and exiting the security identification display area (SIDA) to the north. These travel around the north side of the new facility to the baggage makeup area and beyond to the baggage pickup area on the landside of the terminal building.

Area lighting is inadequate for the new commercial use. With daylight only operations in the schedule and the apron proposed as a temporary solution, no new lighting is proposed for construction. Any night operations will need to be supported with light carts. Should the airport extend operation on the ramp for a longer duration, area lighting will need to be added for both passengers and GSE, although the aircraft shadow to the west will likely require GSE to continue to be supported with portable lighting.

Strengths

No operational issues have arisen at this time. The apron is adequate for one aircraft of the present airliner size (MD-83).

Other Information

The south portion of the apron chevron is adjacent to an FBO and the terminal building. A portion of the ramp is now striped for the aircraft departure, limiting parking at the favored location for itinerant traffic. A flight school had historically parked there and their aircraft have been relocated farther north. Transient general aviation activity is also impacted by Transportation Security Administration (TSA) restrictions on general aviation access to the terminal building directly from the apron. All transient passengers have to pass through the FBO facility and enter the terminal from the landside. This is an issue with the FBO and the transient users who have historically proceeded directly to the terminal from their aircraft.

General Aviation Apron

Description

The general aviation parking facilities at the Airport extend from the angular commercial apron, although the result is three long, narrow rectangular aprons. The facility is constructed in asphalt and is more than adequate for the purpose. Most local pilots have moved into hangars and the apron is generally unoccupied except when infrequently used by some local pilots and transient aircraft. GSE access and storage is at the terminal building/FBO facility. There is no self-service fuel at the Airport.

Operational Challenges / Physical Influences

While size/capacity is no longer an issue, the long and angular layout means significant vehicle traffic to support operations and there are multiple entry gates for landside access. The layout was more readily observable with the historic airport traffic control tower location on the terminal building. The new location of the ATCT to the northeast means the controllers' view of ground operations is somewhat restricted although the AOA is entirely viewable. Fuel tanks are located off airport property and the refueler vehicles regularly enter and exit the apron.

The long, narrow aspect of the apron simplifies the task of designing area lighting and reduces pole height, but the significant build-out of the "landside" edge means there will be significant construction and operations issues. The edge is composed of hangars and taxilanes for hangar access. Underground utility construction will be disruptive and hangar spacing will dictate light pole spacing.

Operational Practices

The aircraft tie-down layout is sized for small aircraft, which somewhat restricts larger refuelers if there should be a significant number of aircraft using the facility. The airport is served by two FBOs operating from three facilities, two of which are in the main terminal area. Both FBOs use the apron to park their refueler trucks and other GSE. Both serve aircraft at any of the aircraft parking areas and can transit the entire ramp to provide service.

Operators have lighted areas as they needed. The main apron areas are not well lighted due to lighting from the edge of the apron. As this is a light use area, there are no plans to improve lighting. Itinerants and local users can park on the eastern edge of the ramps and be well lighted for night operations. Security lighting is not a significant issue, since the airport maintains a night security patrol and there are no unsecured gates.

Strengths

The apron has historically been adequate for general aviation operations and the relatively narrow layout means edge mounted floodlights can reach a greater proportion of the apron than would be common on another airport. GSE entry and exit is at gates adjacent the parking area, simplifying access.

Other Information

None

Helipad Apron

Figure C-23 Ogden Hinckley Airport Helipad Apron
Source: Google Earth Pro.

Description

A lightly used, unlighted helipad is located on the parallel taxiway.

Operational Challenges / Physical Influences

When utilized, traffic is operationally restricted on the taxiways on which the helipad is located.

Operational Practices

The helipad area is not used for aircraft parking.

Strengths

Relatively remote from fixed wing parking areas, the helipad location supports a separation of fixed and rotary wing aircraft.

Other Information

The airport supports helicopter flight training. The trainers make approaches to the runway ends and do not use the helipad.

O’HARE INTERNATIONAL AIRPORT

Terminal Apron

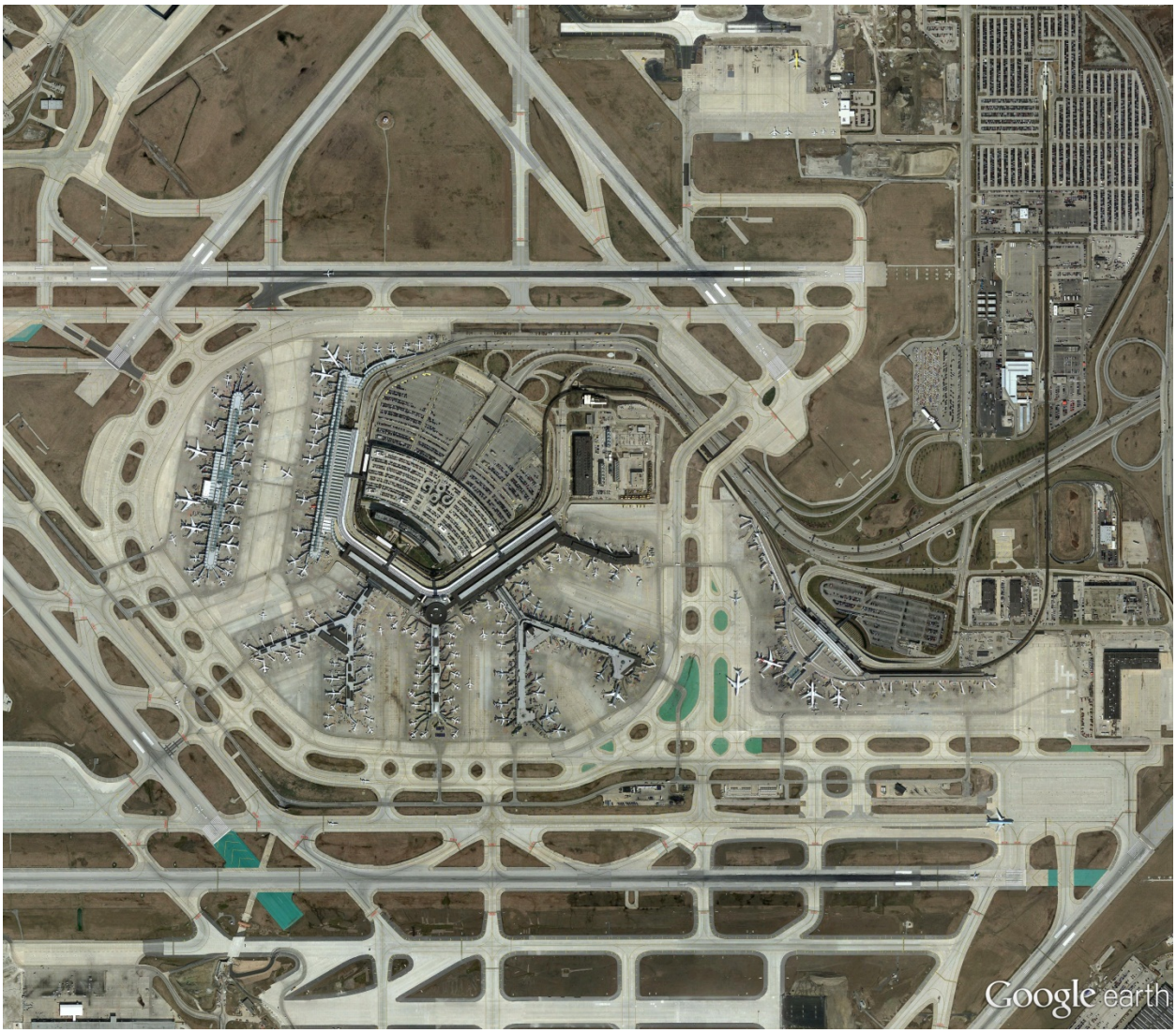

Figure C-24 O’Hare International Airport Terminal Apron
Source: Google Earth Pro.

Description

The airport consists of a variety of terminal apron layouts due to the presence of linear, linear satellite, and pier finger concourses. There is a high volume of vehicle traffic on and near the aprons. All of the pavement surrounding and between the terminals is designated as non-movement area. The terminal core is encircled by two taxiways that define the start of the movement area. Sufficient space between structures allows for efficient vehicle and aircraft movements.

The majority of the gates at the international terminal are adjacent to a non-movement area taxilane.

Aircraft deicing at O’Hare International Airport (the Airport) is conducted on the terminal apron due to the lack of space to accommodate deicing pads in the terminal area or near runway ends.

Remote deicing pads are not utilized at the Airport. Snow removal is conducted by utilizing portable snow melting equipment placed at several locations on the terminal apron.

Operational Challenges / Physical Influences

Vehicle traffic is limited to roadways located behind parked aircraft at the apron limit line. The pier finger concourses result in one-way in and one-way out taxi movements. In addition, there are limited roadways for vehicle access and heavy vehicle traffic exists during peak hub times. The pier finger configuration results in extremely challenging aircraft movements during pavement maintenance and gate construction activities. As compared to a linear concourse, parking is generally limited due to the parking and orientation of aircraft parking positions.

Due to the multiple types and blends of deicing fluid and the remote location of fluid storage, deicing operations greatly increase terminal and roadway congestion. Deicing vehicles travel significant distances for loading and parking.

Snow melting operations require an adequately sized wastewater pipe and the sewer cover must be sufficiently sized to handle the amount of water runoff from the melter. At the Airport, airlines must vacate certain gates positions to facilitate snow storage and melting. Smaller aircraft such as regional jets require that snow piles not exceed predetermined heights for viewing purposes. Avoidance of ground level obstructions such as manholes and hydrant fuel pits is difficult. Snow removal requires an increase in vehicle movements in an already crowded environment.

Operational Practices

The vast majority of ground service equipment vehicles access the non-movement area by crossing active taxiways. Some equipment is permanently staged in the gate area where available. Vehicles routinely move among concourses at will. All aircraft are pushed back from the gates by tractors. The international facility has well-marked roadways which parallel the terminals and allow for efficient vehicle circulation.

Aircraft are deiced at each gate position. During a snow event, an aircraft departure allocation program limits deicing to approximately five total aircraft at any given time. Recovery of liquid deicer/runoff is not required as storm drains are directed into detention and treatment basins.

Contracted equipment including rubber tire skid steer and large capacity wheel loaders, push and pile snow into gate positions or other designated areas that the airlines agree to vacate during snow removal operations. Wheel loaders are equipped with 30-foot wide large capacity box pushers. The snow pile locations are determined by their proximity to adequately sized storm drains. Portable 600 ton per hour snow melters are moved from pile to pile to facilitate snow melting. At the snow piles, (two) six yard wheel loaders load the above grade melters with a continuous payload of snow.

Strengths

For deicing, aircraft are not required to travel to remote deicing locations.

Vehicles generally travel short distances between gates and concourses in the pier finger configuration due to the proximity of gates. The straight linear concourses results in simple vehicle movements that provide excellent visibility of other vehicles and aircraft with limited roadway intersections.

The use of high capacity melters greatly reduces vehicle congestion in the ramp areas and on airport service roads, as compared to hauling snow to remote stock piles.

Other Information

Considerations for snow removal (push and pile, haul out trucking, melting) should be discussed in the early planning process and design of an apron should be enhanced to accommodate these activities. Designers should consider including designated snow storage areas near terminal buildings. Consideration should also be given to in-pavement snow melters.

SAN DIEGO INTERNATIONAL AIRPORT

Terminal Apron

Figure C-25 San Diego International Airport Terminal Apron
Source: Google Earth Pro.

Description

San Diego International Airport (SAN) is a large-hub, commercial service airport, and located approximately three miles northwest of downtown San Diego. The Airport consists of three passenger terminals located on the south side of the airfield. Terminals 1 and 2 provide a total of 51 gates. The Commuter Terminal serves smaller aircraft with five regional aircraft parking positions. Other support facilities include an air cargo service area, one fixed base operator, and remote remain overnight parking. The airport features a single 9,400-foot long east-west runway. The runway is supported by a full length parallel taxiway (B) on the south side and partial length parallel taxiway (Taxiway C) on the north side of the east end. The terminal apron area is located at the west end of the runway south of Taxiway B. There are no parallel apron taxilanes outside the non-movement area adjacent to Taxiway B. The terminal apron is marked with taxilane centerlines and lead-in lines

to the terminal gates. There is a vehicle service road (VSR) parallel to Taxiway B and directly adjacent to the movement/non-movement boundary.

Operational Challenges / Physical Influences

There are several challenges resulting from the terminal and apron configuration at the Airport, including:

Half of Taxiway C requires all arriving aircraft to exit onto Taxiway B directly in front of the Airline Terminals. This increases congestion with aircraft trying to depart from the terminals and can result in head to head aircraft meetings.

Operational limitations during low visibility conditions require arrivals and departures on Runway 9-27 in opposite directions, which results in head to head operations on Taxiway B in front of the terminal aprons. This complicates aircraft circulation and congestion with aircraft trying to depart the terminals.

Operational limitations during low visibility conditions prohibit GSE from using the nearby west end VSR to access the north side of the airfield. This traffic must then use the significantly longer and more congested east end-around route.

Concessions deliveries are accommodated through the airside of the terminals. Space for parking and circulation of delivery vehicles on the terminal apron is very limited.

Trash handling is also accommodated through the airside of the terminals. Space for storing and accessing trash dumpsters and carts on the terminal apron is very limited.

Growing demands for space to accommodate TSA facilities and operations also increases vehicle congestion in the terminal apron area.

Staging, storage, and circulation routes for GSE trying to access/service aircraft must compete with concessions, trash, circulating aircraft, and other vehicles for the limited space available on the terminal apron.

The nighttime noise curfew limits maintenance run-ups on the terminal apron.

Circulation of Group V aircraft is limited and requires special routing due to non-standard Taxiway Object Free Areas (TOFA).

Terminal 2 West expansion limits air traffic control (ATC) visibility of some gate positions. The limited access to and congestion within the apron area and the close proximity of the non-movement make it critical for the ATC to be able to monitor aircraft movement at the gates.

Operational Practices

The Airport conducts months meetings with tenants to review go over critical items such as Foreign Object Debris (FOD) damage, airport safety, and security issues. The Airport maintains a regular schedule for sweeping the terminal and other apron facilities to control the amount of FOD. The airport is constructing a Ramp Control Facility to improve visibility and control aircraft operating at the gates near Terminal 2.

Strengths

The biggest strength is current airport expansion to accommodate operational needs. The airport is adding 10 new terminal gates, 10 new RON parking positions, and a Ramp Control Facility.

Other Information

The airport collaborates monthly with all of its tenants to keep them informed on the status of airport improvement projects and other changes and activities at the airport.