

Terminal Planning Guidelines

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Table of Contents

1.	Overview	1
1.1	Introduction	1
1.2	Use and Organization of the Guidelines	2
2.	Terminal Planning Guidelines.....	3
2.1	General Principles for Terminal Planning.....	3
2.1.1	Terminal Functions.....	3
2.1.2	Terminal Program Definition	4
2.1.3	Analytical Methods	7
2.1.4	Principles for Achieving a Flexible Terminal Plan	7
2.2	Terminal Check-in Facilities.....	10
2.2.1	Overview	10
2.2.2	Programmatic Information	13
2.3	Passenger Security Screening Checkpoints	35
2.3.1	Overview	35
2.3.2	Programmatic Information	37
2.4	Terminal Outbound Baggage Makeup Facilities.....	45
2.4.1	Overview	45
2.4.2	Programmatic Information	47
2.5	Preboarding Areas.....	57
2.5.1	Overview	57
2.5.2	Concourse Programmatic Information	59
2.5.3	Holdroom Programmatic Information	63
2.5.4	Restroom Programmatic Information	77
2.6	Baggage Claim and Inbound Baggage Facilities.....	91
2.6.1	Overview	91
2.6.2	Programmatic Information	95
2.7	U.S. Customs and Border Protection Port of Entry Facilities	107
3.	Annotated Bibliography.....	109
3.1	Annotated Bibliography	109

List of Tables

Table 2-1: IATA Level of Service Wait Time Standard for Check-In (minutes).....	15
Table 2-2: IATA Level of Service Space Standard for Check-In (square feet per passenger).....	15
Table 2-3: IATA Level of Service Space Standards for Security Screening Checkpoints.....	39
Table 2-4: Minimum Circulation Corridor Width (feet).....	60
Table 2-5: Holdroom Sizing – Narrowbody Aircraft.....	64
Table 2-6: Occupancy Calculation (in square feet per passenger).....	81
Table 2-7: Restroom Fixture Calculation.....	82
Table 2-8: Sample Domestic Baggage Claim Area Sizing.....	97
Table 2-9: Sample International Baggage Claim Area Sizing.....	97

List of Exhibits

Exhibit 2-1: Check-in Counter Benchmark, Domestic Service, Linear Configuration.....	17
Exhibit 2-2: Check-in Counter Benchmark, International Service, Linear Configuration.....	19
Exhibit 2-3: Delta Air Lines' Check-in Overlay, LaGuardia Airport, Terminal D.....	23
Exhibit 2-4: Check-in Counter Position Benchmark, Island Configuration.....	25
Exhibit 2-5: Check-in Facility Layout Benchmarks, Rectangular Kiosk Configuration.....	27
Exhibit 2-6: Check-in Facility Layout Benchmarks, Circular Kiosk Configuration.....	29
Exhibit 2-7: Check-in Facility Layout Benchmark, Fully Automated System.....	31
Exhibit 2-8: Check-in Facility Benchmarks, Curbside.....	33
Exhibit 2-9: TSA CDG Checkpoint.....	41
Exhibit 2-10: Expanded TSA Checkpoint.....	43
Exhibit 2-11: Outbound Baggage Makeup Benchmark, Parallel Cart Staging.....	49
Exhibit 2-12: Outbound Baggage Makeup Benchmark, Perpendicular Cart Staging.....	51
Exhibit 2-13: Outbound Baggage Makeup Benchmark, Pier Configuration.....	53
Exhibit 2-14: Outbound Baggage Makeup Benchmark, Height Clearances.....	55
Exhibit 2-15: Double-loaded Concourse Module.....	61
Exhibit 2-16: Narrowbody Aircraft Holdroom Layout, Linear Seating Configuration.....	65
Exhibit 2-17: Narrowbody Aircraft Holdroom Layout, Cluster Seating Configuration.....	67

Exhibit 2-18: Narrowbody Aircraft Holdroom Layout, Derivative Seating Configuration 1	71
Exhibit 2-19: Narrowbody Aircraft Holdroom Layout, Derivative Seating Configuration 2	73
Exhibit 2-20: Holdroom Layout – Concessions Integration	75
Exhibit 2-21: Restroom Layout.....	79
Exhibit 2-22: Restroom Benchmark, LaGuardia Airport, Terminal D.....	83
Exhibit 2-23: Restroom Benchmark, John F. Kennedy International Airport, Terminal 1.....	85
Exhibit 2-24: Restroom Benchmark, John F. Kennedy International Airport, Terminal 4, Concourse B.....	87
Exhibit 2-25: Restroom Location Benchmark, John F. Kennedy International Airport, Terminal 4, Concourse B	89
Exhibit 2-26: Baggage Claim Layout, Through-wall Device.....	93
Exhibit 2-27: Baggage Claim Layout, Carousel Device	99
Exhibit 2-28: Baggage Claim Layout, Inbound Pier	101
Exhibit 2-29: Inbound Pier Overlay, John F. Kennedy International Airport, Terminal 1.....	103
Exhibit 2-30: Baggage Claim Overlay, LaGuardia Airport, Terminal D.....	105

List of Figures

Figure 1: Lufthansa German Airlines, John F. Kennedy International Airport.....	12
Figure 2: Queue Area Wait Time	14
Figure 3: American Airlines, Orlando International Airport.....	21
Figure 4: Bag Drop to Kiosk Ratio	22
Figure 5: Emirates, Dubai International Airport.....	22
Figure 6: Flip Flow Doors.....	36
Figure 7: Flip Flow Doors Dimensions.....	37
Figure 8: Checkpoint Queuing Area Wait Time Capacity	39
Figure 9: Gate 22, John F. Kennedy International Airport, Terminal 5	58
Figure 10: Central Holdroom Concessions, John F. Kennedy International Airport, Terminal 5.....	58

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1. Overview

1.1 Introduction

The airport passenger terminals owned by The Port Authority of New York and New Jersey are operated by private entities, commercial airlines, and the Port Authority. At most of the Port Authority's passenger terminals, aircraft gates are under the control of the terminal operators. Nevertheless, all terminal operator alteration proposals are subject to Port Authority approval under the Tenant Alteration Application (TAA) and permitting process. The TAA references the Port Authority's *Planning & Design for Terminals and Facilities, Airport Standards Manual*, dated May 2005 (First Edition); therefore, the terminal operators are subject to the terms of the Airport Standards Manual (the Manual), where applicable. The Manual establishes a general set of standards and performance criteria to maintain safe, functionally efficient, code-compliant, sound, and acceptable terminal area operations while ensuring airport customer satisfaction in the process. This document updates and retitles the Airport Standards Manual to "Terminal Planning Guidelines" (the Guidelines).

Since publication of the Manual in 2005, customer and tenant satisfaction with terminal facilities has been affected by many changes, including:

- Technology has increased the number of options customers have to complete their in-terminal transactions i.e. self-service kiosks and self-tagging of baggage at check-in.
- A dynamic security environment stemming from changing passenger and baggage screening protocols continues to define the in-terminal experience of airport customers.
- Globalization of airline alliances and terminal concession programs has raised customer expectations for a consistent level of quality throughout all segments of their airline travel.
- Distinctive airline operating/business strategies are being manifested in the design of new facilities.

Although the Port Authority's purview over such changes is clearly limited, this document discusses how such changes should be considered when applying consistent planning principles. The Guidelines (a) incorporate changes to important spatial criteria and requirements brought about by emerging industry trends; (b) enhance user understanding of issues that should be considered in developing or evaluating the programmatic basis for designing terminal facilities; and (c) expand the information included in the Manual to address important terminal facilities that were not discussed in the Manual.

The Guidelines are based on information acquired through reviews of current federal and industry literature providing terminal facility guidelines; reviews of completed contemporary terminal facilities outside of and within the Port Authority's jurisdiction; and the knowledge, expertise, and opinions of Port Authority staff.

1.2 Use and Organization of the Guidelines

These Port Authority Terminal Planning Guidelines are intended as an initial source of guidance for developing spatial requirements for common in-terminal facilities used to process passengers and their baggage. As such, supplemental references are provided to external publications that describe, in more detail, acceptable methodologies for calculating activity – specifically, peak daily and peak hourly activity, quantifying processor capacities, and deriving discrete processor requirements. New and emerging trends are also discussed to increase awareness of their potential effects on current guidance and the reasoning behind adoption of the current guidelines. These Guidelines are intentionally focused on a discussion of the fundamental principles and methodologies that should be considered when developing terminal requirements and layouts rather than mandated standards; even so, the Guidelines and supplemental references convey the Port Authority's expectations for development or refurbishment of its terminals to consistently meet the quality service standards described herein.

This document begins with an overview of general terminal planning principles that should guide the development of programmatic requirements, followed by detailed guidelines affecting common terminal components, such as check-in facilities, passenger security screening checkpoints, outbound baggage makeup facilities, preboarding areas (consisting of holdrooms, concessions, and restrooms), baggage claim and inbound baggage facilities, and U.S. Customs and Border Protection Port of Entry Facilities.

2. Terminal Planning Guidelines

2.1 General Principles for Terminal Planning

2.1.1 TERMINAL FUNCTIONS

Terminals consist of discrete functional components that should be viewed as interconnected subsystems, which typically include:

- Landside (non-secure) passenger processors
 - *Departing passengers*: main check-in area (terminal lobby and curbside) and departures concourse
 - *Arriving passengers*: baggage claim and arrivals concourse
 - Concessions
- Airside (secure) departures concourses
 - Preboarding lounges
 - Concessions
 - In-transit lounges
- Checked baggage handling areas
 - Outbound flight baggage makeup
 - Inbound flight baggage unloading
- Government inspection areas
 - Passenger security screening
 - Customs and Border Protection functions
 - Checked baggage screening

Interconnectivity between these subsystems should be delineated using flow charts to depict movement between components by different user groups, typically representing: passengers, meeter/greeters, employees, baggage, and materials/goods/supplies. Flows by passenger type should be further delineated to

consider departures, domestic arrivals, international arrivals, and transfers/connecting flows as the activity levels within each of these categories create demand on different terminal subsystems.

Supplemental References

- International Air Transport Association (IATA) *Airport Development Reference Manual (ADRM)*: Chapter B, Section 1.4, "Key Characteristics of a World-Class Airport", 2004.
- Transportation Research Board (TRB), Airport Cooperative Research Program (ACRP) Report 25: *Airport Passenger Terminal Planning and Design*, Vol. 1, Chapter VI, Section 2.2, "Flow Sequences", 2010.
- Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*: Figure 3-1, "Functional Adjacency Diagram", 2011.

2.1.2 TERMINAL PROGRAM DEFINITION

Terminal programs are typically defined by four principal elements: project parameters, namely goals and objectives; demand basis; level of service standards; passenger profiles and characteristics; and space program. These principal elements provide the basis for developing an implementation strategy and program budget.

Project Parameters

Defining the project parameters represents the critical initial step of developing consensus among project stakeholders regarding motivations, need, financial basis, and any distinctive project qualities. Project parameters are typically expressed as goals and objectives, which become criteria for evaluating alternative concepts at later stages in the planning and design process.

- As an example of project parameters, contained in the IATA ADRM, Section 1.4, titled "Key Characteristics of a World-Class Airport" lists qualities of airports that are highly rated by airlines and passengers.
- Important air service parameters, typically discussed as part of the aviation activity forecasts, include: aircraft fleet mix, airline flight schedules, air service sectors (domestic and international), and the shares of originating/terminating and connecting passengers.
- Operating and financial parameters are typically contained in the Airline-Airport Operating Agreement, which includes rules governing facility use by tenants, rules for common-use facilities, and the basis for calculating airline rates and charges.

Demand Basis

Terminal facilities are planned, sized, and designed for initial construction to accommodate peak passenger demands for a selected forecast period, which is generally within 5 to 10 years of the current period. Planners of terminal facilities principally use hourly activity statistics consistent with the average day of the peak month baseline. Detailed planning, concept validation, and design studies should be based on project-specific planning day flight schedules that reflect the basic air service characteristics for the project, including:

- Airlines operating at the airport
- Aircraft types and seating configurations
- Departure and arrival times
- Traffic sector (domestic or international)
- Load factor and proportion of originating/terminating, and transfer passengers
- Gate positions

The planning day flight schedule should be analyzed for different traffic sectors, passenger and baggage flows, and, depending on the rules for facility use, different airline groups or individual airline use, as peak demand on terminal subsystems by different traffic sectors occurs at different times throughout the day.

Flight delays, common in long-haul flights, can drastically change airport activity, which isn't captured in a planning day flight schedule. Additional sensitivity analysis on demand activity is recommended to accommodate delay factors in facility planning.

The demand basis for planning certain terminal subsystems does not rely on peak numbers of passengers, as much as considerations for the predominant aircraft fleet operating at the airport. For example, it may be preferable to size preboarding lounges (holdrooms), gate positions, and baggage claim devices to accommodate the largest aircraft listed in the planning day flight schedules.

Level of Service Standards

Demand is analyzed using level of service (LOS) standards that define the desired performance for different terminal components. IATA's level of service framework is widely accepted as a means of comparing performance or capacity among different terminal components. The IATA frameworks provide a range of evaluation criteria (LOS A through F) to measure different conditions for circulation flows, spatial comfort, and wait times. Planning to LOS standards has implications on the size of the terminal and construction cost. LOS C is generally accepted as providing a good level of service at a reasonable cost.¹

The analyses correlating demand to level of service should provide quantifiable requirements for each terminal component that can be converted into space requirements; for example:

- Demand basis
- LOS evaluation criteria
- Required number of processor units (check-in positions, baggage claim devices, screening lanes, etc.)
- Number of peak period passengers in queue

¹ As the IATA LOS framework is presented as a range, there is sometimes confusion over its interpretation. The LOS criteria listed under each value (A through F) should be understood as the minimum for the specific value.

Passenger Profiles and Characteristics

Passenger profiles and characteristics correlate demand and level of service to establish facility requirements for terminal facilities, such as check-in facilities and security screening checkpoints, which are not dependent on equipment types. The passenger profiles and characteristics incorporate unique airport- and airline-specific sets of assumptions typically obtained from airport observations, surveys, and historical data and are applied to the planning day flight schedule. These assumptions are organized into two components: passenger attributes and show-up profiles.

Passenger attributes determine the distribution of passenger types into group size, gender, travel class (first class, business, or economy), check-in type, and landside modal split. Check-in type identifies the percentage of passengers checking bags, number of checked bags per passenger, and which type of check-in equipment each passenger is expected to use (kiosks, bag drop, or agent-assisted positions). Landside modal split indicates the mode of transportation passengers use to get to the airport (private vehicle, rental car, shuttle bus, bus, taxicab, or train).

The passenger show-up profile is defined as the earliness distribution of passengers arriving at the terminal prior to the scheduled time of flight departure. Departing passenger show-up profiles are influenced by multiple elements, including domestic or international destination, mode of transportation (landside modal split), distance from the airport, and specific passenger attributes (i.e., passengers checking bags and check-in type), check-in counter close-out times for baggage check, and time of day for scheduled flight departure.

Space Program

The space program quantifies the amount of space required for each terminal component to accommodate the demand set forth in the aviation demand forecasts. For existing terminals, the capacity of each component should also be assessed to determine the gap between the capacity provided by existing components and the capacity required in the future. Developing a refined space program requires an iterative process to transform analyses into a preferred concept layout (plan). An initial space program is derived by correlating the required number of processor units to a dimensional template of the space that illustrates the processor unit(s) module in the context of equipment placement and clearances for servicing, circulation, and associated staging/waiting/ holding areas. The initial space program is then used to develop conceptual layouts that integrate the individual terminal components into an optimal overall terminal configuration. The optimal configuration will have been developed with consideration of the specific physical conditions for the project, such as: site (airfield and landside conditions), adjacent existing and planned terminal facilities, and blocking and stacking of new terminal components, as well as commercial objectives that may influence the arrangement of the terminal's basic functional processors.

Supplemental References

- IATA ADRM:
 - Chapter B, Section 1.4, "Key Characteristics of a World-Class Airport"
 - Chapter F, Section 4, "Planning Schedule"
 - Chapter F, Section 9.1.2, "Level of Service"

- FAA AC 150/5360-13, Paragraph 22, "Translating Forecasts to Peak Demands"
- ACRP Report 25: *Airport Passenger Terminal Planning and Design*, Vol. 2, *Spreadsheet Models and User's Guide*, "Design Hour Determination Model"

2.1.3 ANALYTICAL METHODS

Developing a contemporary terminal program is complex as it involves operational and statistical analyses, queuing theory, and mathematical modeling of inter-related dynamic processes. While rules of thumb for sizing terminal components are available, the simplification and approximations used in those formulas limit their application to rudimentary analyses. Moreover, detailed spreadsheet models and computer simulation should be used to provide a more accurate evaluation of terminal requirements tailored to a terminal's forecast air service and passenger activity.

- The TRB, through the ACRP, has made available a series of related spreadsheet models that include practical learning exercises and several airport-specific sample data sets to assist users in determining appropriate model inputs for their specific situations. Queuing models embedded within each terminal component's spreadsheet provide users the ability to analyze the sensitivity of expected wait times and required queuing areas to variations in the number of processor units, such as counters or lanes.
- Computer simulation modeling allows *in situ* analysis of the effects of flight activity, operating parameters, passenger characteristics, and physical terminal characteristics on passenger flows to create demand on individual terminal components. Simulation is used to analyze flows and passenger-processor interactions within individual terminal components, and to establish links between upstream and downstream components to determine limiting factors and requirements of the terminal as a whole. Airport simulation software currently available includes Comprehensive Airport Simulation Technology (CAST) *CAST Terminal*; AirTOPsoft *Airport Passenger Terminal*; and ARCport *ALTO (Airside, Landside, Terminal and Onboard)*.

Whether a spreadsheet model or computer simulation is used to develop the terminal space program, the basic elements needed to conduct the analyses include project parameters, the demand basis, and level of service criteria.

Supplemental References

- IATA ADRM:
 - Chapter F, Section 9.9.2, "Simulation"
 - Chapter F, Section 9.10, "Rules of Thumb"
- ACRP Report 25: Vol. 2, *Spreadsheet Models and User's Guide*

2.1.4 PRINCIPLES FOR ACHIEVING A FLEXIBLE TERMINAL PLAN

Terminals represent large capital investments and have features that are, for the most part, permanent and usually require major additional investments to modify them. Within the past 20 years, the operators of

airports worldwide have necessarily made significant investments to transform their terminal operations in response to changes in the security environment, new aircraft models, Internet-based technology applications, demographics, airline business strategies, and airport commercial strategies, among others. Change is a certainty, and the pace of change is quickening.

The *Airport Terminal of the Future* workshop, sponsored by the Port Authority on September 19, 2012, described important qualitative aspects of the terminal of the future with implications on terminal planning:

- Passengers will experience an intuitive and seamless free-flow conditions that they can control, engage in, and enjoy in a manner and timeframe they control from the time they leave home to the time they arrive at their final destination.
- Passengers will experience a free-flowing process rather than a single sequential linear process. With the growing development of mobile technology and new airline products, passengers will be offered a highly tailored experience that will be increasingly differentiated and in which all passengers of a given airline will no longer gather in the same physical space to undergo essentially the same process.
- Processes will be integrated among the airport community, including airlines, concessions, and regulators, from both physical and business model perspectives. The model of individual tenants operating in isolation is becoming rapidly outdated. The technical tools and systems, particularly mobile devices and shared databases, will enable development across the industry, not just within a single entity, such as an airline or concessionaire. The airport operator will become the central broker for multiple shared processes.

Both IATA and ACRP have published principles for developing a physical terminal plan, and highlighted important trends in technology applications and concessions planning that should be considered to improve the long-term flexibility of terminals.

Physical Plan

- Linear terminal designs are generally easier to expand, particularly if they are based on a modular approach to the terminal and incorporate repetitive structural elements.
- Ample floor-to-floor heights (rights-of-way for mechanical/electrical, conveyance, information technology, and data systems), circulation, and transition spaces should be provided.
- Nonpermanent building plan elements used to define circulation patterns improve the flexibility to reconfigure tenant and functional areas.
- Networked circulation systems improve accessibility throughout sequential functions.
- Level changes and linear nodal designs create large space requirements with associated centralization of building infrastructure that can potentially constrain long-term flexibility.
- Transitional zones placed crosswise to passenger flows provide long-term flexibility to expand functional components of the terminal.

- The integrity of the apron to accommodate changes in aircraft fleet mix and gating requirements should be maintained.

Technology

Technologies, particularly passenger self-service technologies, have become critically important to the airlines and their passengers. Self-service technology platforms now include fixed in-terminal units, such as kiosks and interactive displays, and personal computing (mobile) devices, such as tablets and smartphones. Applications for self-service technologies have expanded beyond the check-in process to regularly include lost/delayed baggage recovery, various forms of document checks, automated flight rebooking/upgrade notifications, and self-boarding. IATA envisions that, by 2020, 80 percent of global passengers will be offered a complete self-service suite. The rapid adoption of technology is underpinned by a range of incentives that include lowered operating costs, consistent and improved service delivery, increased use of infrastructure, and reduced areas of congestion from decentralization and improved processing throughput.

In the discussions of individual terminal components, these Guidelines discuss relevant forms of technology.

Concessions

In-terminal concession programs are important contributors to the financial performance of contemporary airports and have gained a higher profile as the operators of competing airports improve their concession programs and raise the expectations of travelers and civic leaders. Increasingly, passenger regard for a terminal's concession program is closely related to satisfaction with their overall airport experience. Attributes shared by highly regarded and financially successful concession programs are often cited for their aesthetics, sense of place or strong theme, perception of good value, and variety.

Less time spent pre-security and longer security checkpoint processing times have increased demand for post-security concessions. ACRP Report 54, *Resource Manual for Airport In-Terminal Concessions*, 2011, notes that a survey of airport operators found a preference for allocating 79 percent of total in-terminal concession space post security at medium hub airports and 85 percent of total concession space post security at large-hub airports. Other important considerations affecting the location of concession spaces include:

- Concentration into concession zones enhance creation of "sense of place" and design themes, while minimizing visual interruptions.
- Walk-through concession areas increase passenger flows past concessions.
- Incorporation of concessions into holdroom seating areas to increase revenue generation.

Supplemental References

- Port Authority of New York and New Jersey, *Airport Terminal of the Future Workshop - Notes and Highlights*, September 19, 2012
- ACRP Report 25: Vol. 1, *Guidebook*, 2010.
 - Chapter VI, Section 1.5.7, "Considerations for Achieving Flexibility in an Uncertain Future"

- Chapter III, Section 9.3, “Concession Planning”
- ACRP Report 54, *Resource Manual for Airport In-Terminal Concession*, 2011.
 - Chapter I, Section 1.1, “Changes in Airport In-Terminal Concessions Programs”.
- ACRP Report 10, *Innovations for Airport Terminal Facilities*, 2008.
- IATA ADRM: Chapter F, Section 9.1, “Passenger Terminal Design: Introduction”, 2004.
- IATA, Copart, Stephan, *Fast Travel Program Strategy*, Revision 5, May 2012.

2.2 Terminal Check-in Facilities

2.2.1 OVERVIEW

Check-in is the first process undertaken by departing passengers at an airport. The check-in process allows passengers to check non-carry-on baggage with the airline and obtain boarding passes. During check-in, passengers receive specific flight information, have the ability to purchase additional in-flight services (such as priority boarding, and upgrade seat assignments), and adjust their flight arrangements (reservations). At check-in, airlines verify passenger’s identification documents and flight reservations and collect any outstanding fees.

Check-in processes and options can take many forms depending on the airline and the airport. In some cases, airlines offer passengers the option of completing the check-in process entirely off-airport—at hotel locations, for example. In most cases in which off-airport check-in involves checking passenger bags, a bonded third party provides such services, including acceptance and secure delivery of checked bags to the airport for security screening. Off-airport check-in processes most commonly used in the United States involve online check-in, which allows passengers with Internet access to obtain boarding passes, enter information and pay fees related to checked baggage charges, change their reservations, and upgrade in-flight services.

Passenger acceptance and preference for off-airport and online check-in options have reduced the amount of terminal space historically needed for terminal check-in as certain passengers bypass airport check-in entirely and proportionally fewer agents are needed to serve the same number of departing passengers. The number of passengers bypassing airport check-in is increasing with passengers using mobile check-in applications (i.e., apps) to replace paper boarding passes with digital boarding passes that display Quick Response codes on a passenger’s mobile device.

For the most part, the in-terminal check-in process is evolving to acceptance of checked baggage (non-carry-on baggage) from passengers, and in the case of certain travel destinations, to validation of travel documents by airline agents.

The terminal check-in process continues to evolve with increasing reliance on passenger self-service transactions. Self-service equipment, by design, has a smaller physical footprint and is less costly to operate than an agent-staffed ticket counter, which allows greater deployment of self-service units within a given area

and increases the number of positions where passengers can complete check-in transactions. Self-service options increase the overall throughput of terminal check-in facilities by increasing the number of transaction terminals available to passengers, which minimizes the time that passengers traditionally spend waiting for an airline agent and reduces the transaction times agents spend with passengers to complete the check-in process. Transactions that can be conducted at self-service kiosks include those otherwise available online and, increasingly, the ability to acquire bag tags that passengers can self-apply to their non-carry-on baggage. This latter process is referred to as self-tagging. Currently, the Transportation Security Administration (TSA) requires that airline agents physically accept self-tagged baggage from passengers at a bag drop location (typically a counter); however, at non U.S. airports, airlines offer passengers options for fully automated (self-service) baggage drop procedures.

Use and lease agreements between terminal operators and airlines can affect the appearance of equipment and configurations used to support the check-in process. As a trend, preferential and jointly leased facilities are replacing exclusively leased facilities—in part in response to conditions used to determine eligibility for the collection of passenger facility charges (PFCs). Preferential use gives the terminal operator the right to assign the use of certain facilities to other airlines on a second-priority basis when such facilities are not reasonably required for the “preferred” airline's operations. Joint use and common use facilities are used by more than one airline for similar purposes, which have increased terminal operator installations of common use passenger processing systems (CUPPS) and common-Use self-service (CUSS) devices. Industry adoption of centralized baggage handling systems and Centralized Baggage Inspection Systems represent corollary developments that facilitate deployment of CUPPS and CUSS devices for airport check-in.

Establishing the terminal check-in processes and facility assignments (use premise) is critical to properly planning these facilities.

Trends and Innovations

Automation, innovations, and social behaviors are increasingly changing most passengers' flight check-in experience from the ubiquitous ticket agents standing behind check-in counters to self-service interactive displays—usually with roaming airline agents performing as personal assistants. In addition, the appearance of in-terminal check-in facilities is evolving as an extension of an airline's brand (see **Figure 1**) or a terminal brand (for example, a low cost carrier terminal). Underpinning this evolution is the adoption of near field communication applications, such as going paperless and Internet-based transactions using mobile devices. These technologies are enabling the airlines to reduce the cost of most transactions and, instead, to offer segmented services, such as concierge-style flight check-in services for premium passengers. In other words, certain passengers will be offered a highly tailored experience that will be increasingly differentiated and decentralized compared with the current experience in which all passengers of a given airline gather in the same physical space for essentially the same processes.

Figure 1: Lufthansa German Airlines, John F. Kennedy International Airport

SOURCE: [www.Lufthansa.com](http://www.lufthansa.com), (http://www.lufthansa.com/us/en/Check-in-machine?blt_p=DE&blt_l=en), Accessed August 9, 2013.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Universal installation of automated baggage handling systems and Common-Use Terminal Equipment (CUTE) will be an important corollary trend to support innovative ideas for decentralizing flight check-in facilities. Continuing innovations in support of these trends will most likely include:

- Increasingly integrated processes among the airport community using near field communication devices for flight check-in, as well as at all document touch-points and as a “wallet” within the terminal complex (landside and airside).
- Online and offsite flight check-in processes overtaking in-terminal check-in and increasing the number of passengers bypassing in-terminal flight check-in areas altogether.
- Separate premium passenger flight check-in through security.
- Check-in facility appearance designed to reflect airline and/or terminal operator brand.
- On a trial basis, implementing different forms for tagging checked bags, ranging from improved adhesives, tags slipped into plastic sleeves, radio-frequency identification (RFID) chip-enabled tags, and bags with embedded RFID chips.
- Expanded flight check-in options at off-airport and on-airport (other than in-terminal) locations.

Supplemental References

- Port Authority of New York and New Jersey, *Airport Terminal of the Future Workshop - Notes and Highlights*, September 19, 2012
- ACRP Report 10: *Innovations for Airport Terminal Facilities*, 2008.
- ACRP Report 30: *Reference Guide on Understanding Common Use at Airports*, 2010.
- ACRP Report 35: *Planning for Offsite Airport Terminals*, 2010.
- ACRP Report 41: *Guide to the Decision-Making Tool for Evaluating Passenger Self-Tagging*, 2010.
- IATA, Copart. Stephan, *Fast Travel Program Strategy*, Revision 5, IATA, May 2012.
- IATA ADRM:
 - Chapter F, Section 9.1.3, "Check-In Queue Area"
 - Chapter J, Section 9, "Check-In"
- ACRP Report 25: Vol. 1: *Guidebook*, Section VI.3.2, "Ticket/Check-in Lobby"
- FEMA, *Site and Urban Design for Security: Guidance against Potential Terrorist Attacks* (FEMA 430), February 1, 2008.

2.2.2 PROGRAMMATIC INFORMATION

Flight check-in requirements define the amount of space needed to accommodate the types and numbers of check-in positions (baggage drop, self-service kiosks, and curbside) and queuing areas required to support terminal activity. Performance criteria are applied to activity (demand) levels to determine the required number of check-in positions. Dimensional criteria based on level of service criteria and operating requirements are then applied to the required number of check-in positions and the number of passengers in transaction waiting areas (queue) to derive the initial space program.

For detailed planning, separate analyses would have to be conducted for each airline operating in the terminal, and differences in operating parameters and passenger characteristics among the airlines would have to be considered. Individual airline requirements should be aggregated according to rules for terminal facility use (exclusive, preferential, or shared) to formulate the overall program requirement for check-in facilities. Information used to develop check-in facility requirements include:

- Operating parameters
 - Rules for use: counter availability and close-out time, use/lease basis, check-in options
 - Processing rates
- Demand basis
 - Planning schedule analyses by airline
 - Flight check-in options and passenger class of service

- Passenger behavior: show-up time at terminal ahead of flight departure time, check-in option preference, number of bags checked, and group size
- Level of service criteria
- Dimensional criteria (space template)

Level of Service and Spatial Planning Guidelines

Check-in demand is analyzed using level of service standards that address performance in terms of the time passengers wait for processing and the space allotted each waiting passenger. The IATA level of service guidelines for check-in wait times and waiting areas space per passenger are shown in **Table 2-1** and **Table 2-2**, respectively.

- The acceptable wait time in queue for passengers should not exceed 12 to 30 minutes, but may be under 3 minutes depending on the class of passenger and flight sector (for example, domestic versus international).
- Space standards vary and are principally affected by the number of checked bags per passenger and the use of baggage carts. Even so, IATA recommends that queue areas be able to accommodate the numbers of passengers waiting up to 30 minutes in queue to account for demand surges occurring during peak periods and fluctuations in staffing. **Figure 2** provides the formula for calculating queue area allowances based on wait time.

Figure 2: Queue Area Wait Time

$$\text{Wait Time (min)} = \frac{\text{Total Queue Area (sf)}}{\text{LOS (sf/pax)}} \times \text{Avg. Transaction Time (min/pax)}$$

$$\text{Wait Time (min)} = \frac{144 \text{ sf}}{14 \text{ sf/pax}} \times 3.0 \frac{\text{min}}{\text{pax}} = 30 \text{ min}$$

The acceptable amount of time that passengers wait for service coupled with transaction times are the primary factors used to determine the supply of check-in positions needed and the number of passengers in queue. Space allowances for each passenger in queue are applied to the number of passengers in queue to calculate the minimum areas required for queuing.

Table 2-1: IATA Level of Service Wait Time Standard for Check-In (minutes)

	SHORT TO ACCEPTABLE	ACCEPTABLE TO LONG
Economy Check-in	0-12	12-30
Business Class Check-in	0-3	3-5

SOURCE: IATA ADRM, 9th Edition, Effective January 2004.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Table 2-2: IATA Level of Service Space Standard for Check-In (square feet per passenger)

	A	B	C	D	E	F
Few carts and few passengers with check-in baggage	18.3	15.0	12.9	11.8	9.6	<9.6
Few carts and 1 or 2 pieces of baggage per passenger	19.4	16.1	14.0	12.9	11.8	<11.8
High percentage of passengers using baggage carts	24.8	20.5	18.3	17.2	16.1	<16.1
'Heavy aircraft' flights with 2 or more items per passenger and a high percentage of passengers using baggage carts	28.0	24.8	21.5	20.5	19.4	<19.4

NOTE:

1. Recommended row width between queue stanchions: 4.0 feet to 4.5 feet.

SOURCE: IATA ADRM, 9th Edition, Effective January 2004.

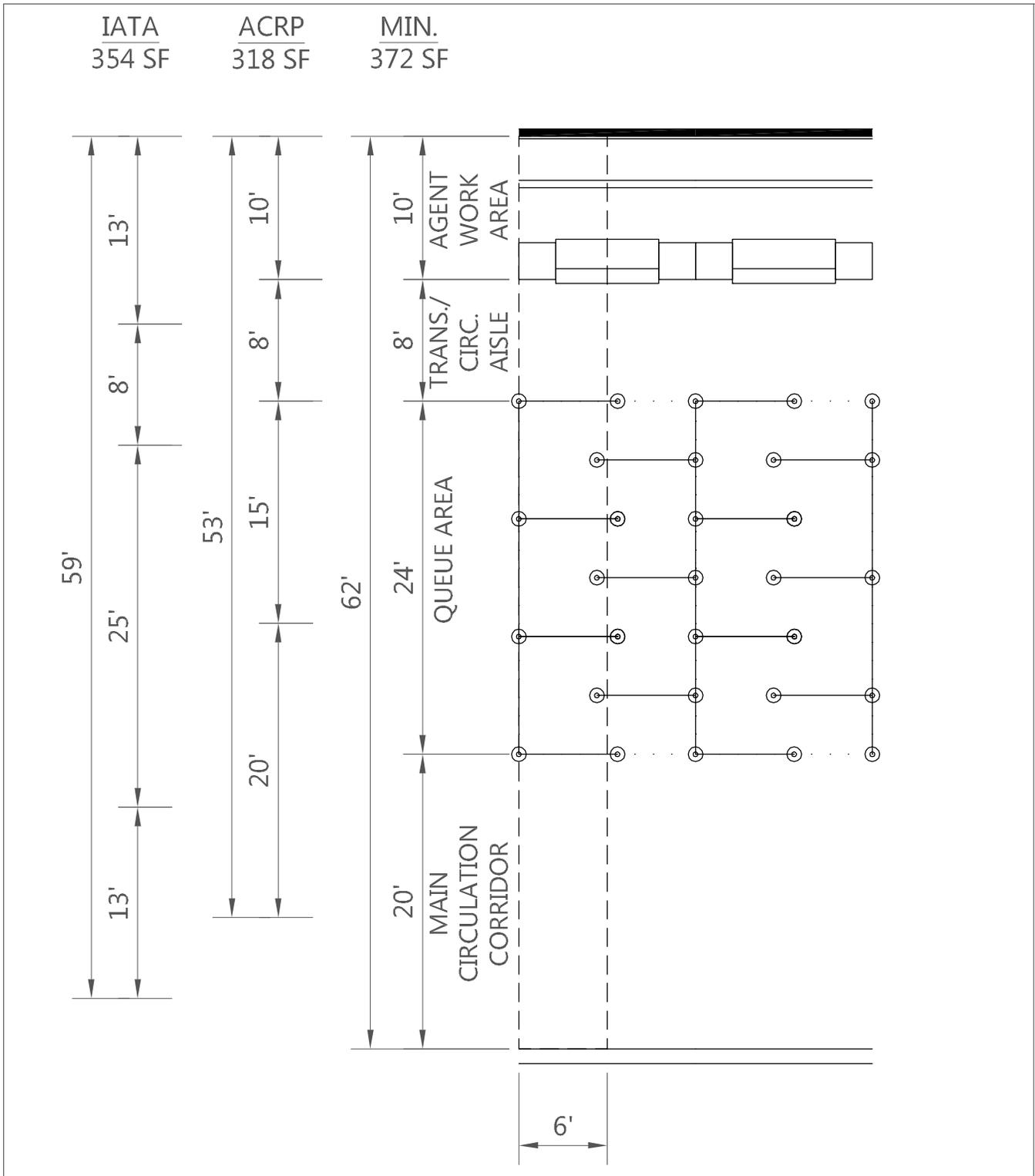
PREPARED BY: Ricondo & Associates, Inc., August 2013.

Dimensional Guidelines

The dimensional guidelines for the most common airline agent check-in position modules are approximately 370 square feet for counter positions used for domestic flights and 405 square feet for counter positions used for international flights, as illustrated on **Exhibit 2-1** and **Exhibit 2-2**, respectively. A single module consists of:

- Agent counter and baggage scale
- Agent work area, including the baggage take-away conveyor
- Transaction/circulation aisle separating the baggage drop from the queue area
- Queue area
- Main circulation corridor

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SOURCE: Source IATA ADM, ACRP Report 25, June 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

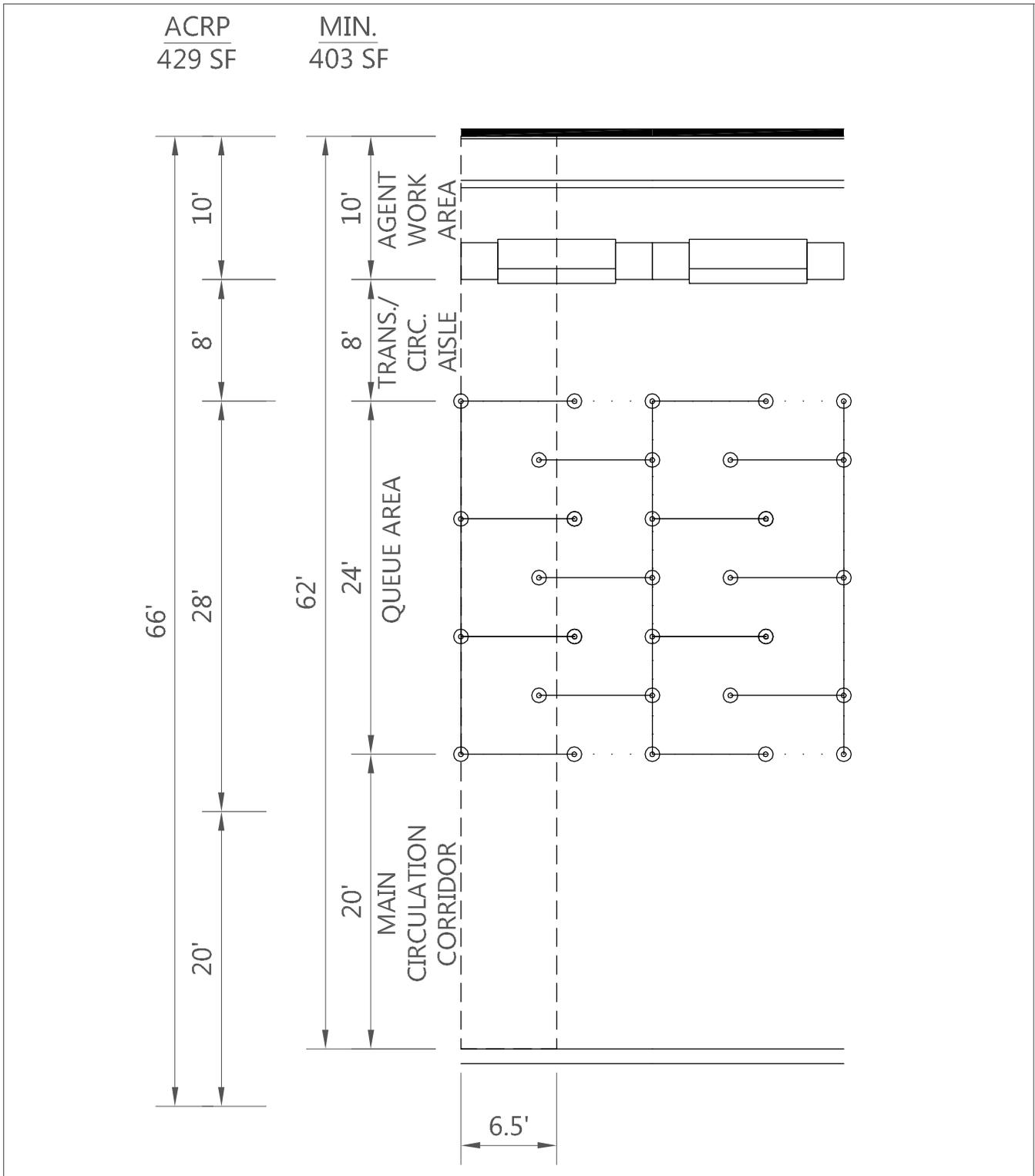
EXHIBIT 2-1



Check-In Benchmark Domestic Linear Configuration

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SOURCE: ACRP Report 25, June 2013.
 PREPARED BY: Ricondo & Associates, Inc, August 2013.

EXHIBIT 2-2



Check-In Benchmark International Linear Configuration

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Exhibit 2-3 illustrates IATA and ACRP dimensional guidelines overlay on the check-in facilities for Delta Air Lines at LaGuardia Airport, Terminal D. The linear check-in counter configuration can be arranged in a linear or island counter orientation.

- A linear check-in counter orientation presents ticket counters parallel to the terminal curb, although there are instances in which linear counters are double sided, with one side facing away from the terminal curb. Commonly, airline ticket offices (ATOs) are located directly behind the agent work area in this configuration.
- The island check-in counter configuration is most common at large international terminals where counter length is more critical than curb frontage. Island check-in counters provide flow-through circulation and ATOs are sometimes located remote from the counters. In an island configuration, similar spacing is assumed between check-in counters and a central circulation aisle (**Exhibit 2-4**).

Derivative Layouts

Flight check-in facility layouts continue to evolve as airlines and airport operators integrate new technologies and procedures to increase self-service functions. **Exhibit 2-5** and **Exhibit 2-6** illustrate the dimensional guidelines for a commonly found combination of baggage drop counters and self-service kiosks. Equipment required for self-tagging and baggage drops generally allow the required functions to be incorporated within the traditional 12-foot-wide two-position check-in module (see **Exhibit 2-7**). In trials conducted by different airlines and industry groups, it was found that the two-step process (separate self-service kiosk and baggage drop locations) produces a higher throughput compared with a one-step process (see **Figure 3**). Provided that a sufficient number of kiosks are provided, passengers are able to initiate their flight check-in process upon entering the terminal, and agent-staffed baggage drop positions are able to increase throughput because their principal functions are limited to validating documents and accepting the tagged baggage. **Figure 4** provides a basic formula for calculating the ratio of kiosks to baggage drop positions.

Figure 3: American Airlines, Orlando International Airport



SOURCE: Ricondo & Associates, Inc., May 2013.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Figure 4: Bag Drop to Kiosk Ratio

$$Bag\ Drop:Kiosk = \frac{Total\ 1\ bag\ drop\ (pos.)}{x\ Kiosk\ (pos.)} = \frac{Avg.\ Bag\ Drop\ Trans.\ Time(pax/min)}{Avg.\ Kiosk\ Trans.\ Time(pax/min)}$$

$$Bag\ Drop:Kiosk = \frac{Total\ 1\ bag\ drop\ (pos.)}{x\ Kiosk\ (pos.)} = \frac{2\ pax/min}{0.33\ pax/min} = 1\ Bag\ Drop:3\ Self - Tag\ Kiosks$$

Outside the United States, fully automated baggage check-in systems have been installed at several airports. These systems allow passengers to complete an entire check-in transaction, including baggage drop transactions, without interacting with an airline agent (see **Figure 5**). Within the United States, self-service check-in requires an airline agent to validate travel documents and place the checked baggage into the baggage conveyance system.

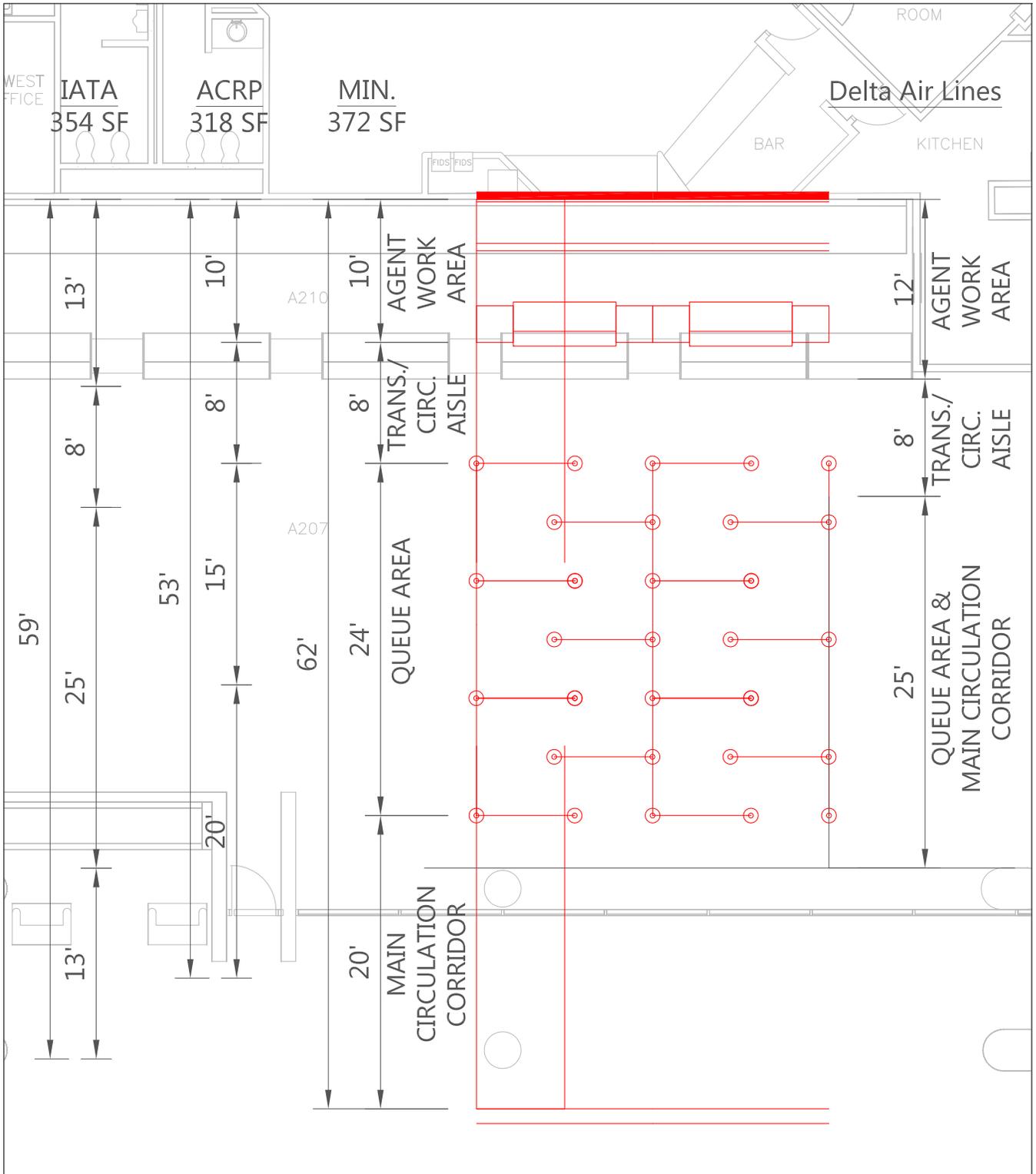
Figure 5: Emirates, Dubai International Airport

SOURCE: Ricondo & Associates, Inc., January 2012.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Curbside check-in is an option offered at many airport terminals and is dimensionally similar to standard check-in counters. Curbside check-in facility planning and design should comply with Americans with Disabilities Act (ADA) and Federal Emergency Management Agency (FEMA) regulations for terminal façade fortification. Dimensional guidelines for curbside check-in, as well as ADA and FEMA bollards design guidelines, are illustrated on **Exhibit 2-8**. These guidelines relate to:

- Curbside counter includes agent work area, counter, and baggage scale
- Transaction/circulation aisle, queue area, curbside circulation corridor with bollards
- Bollards to curb edge
- Interval between bollards



SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

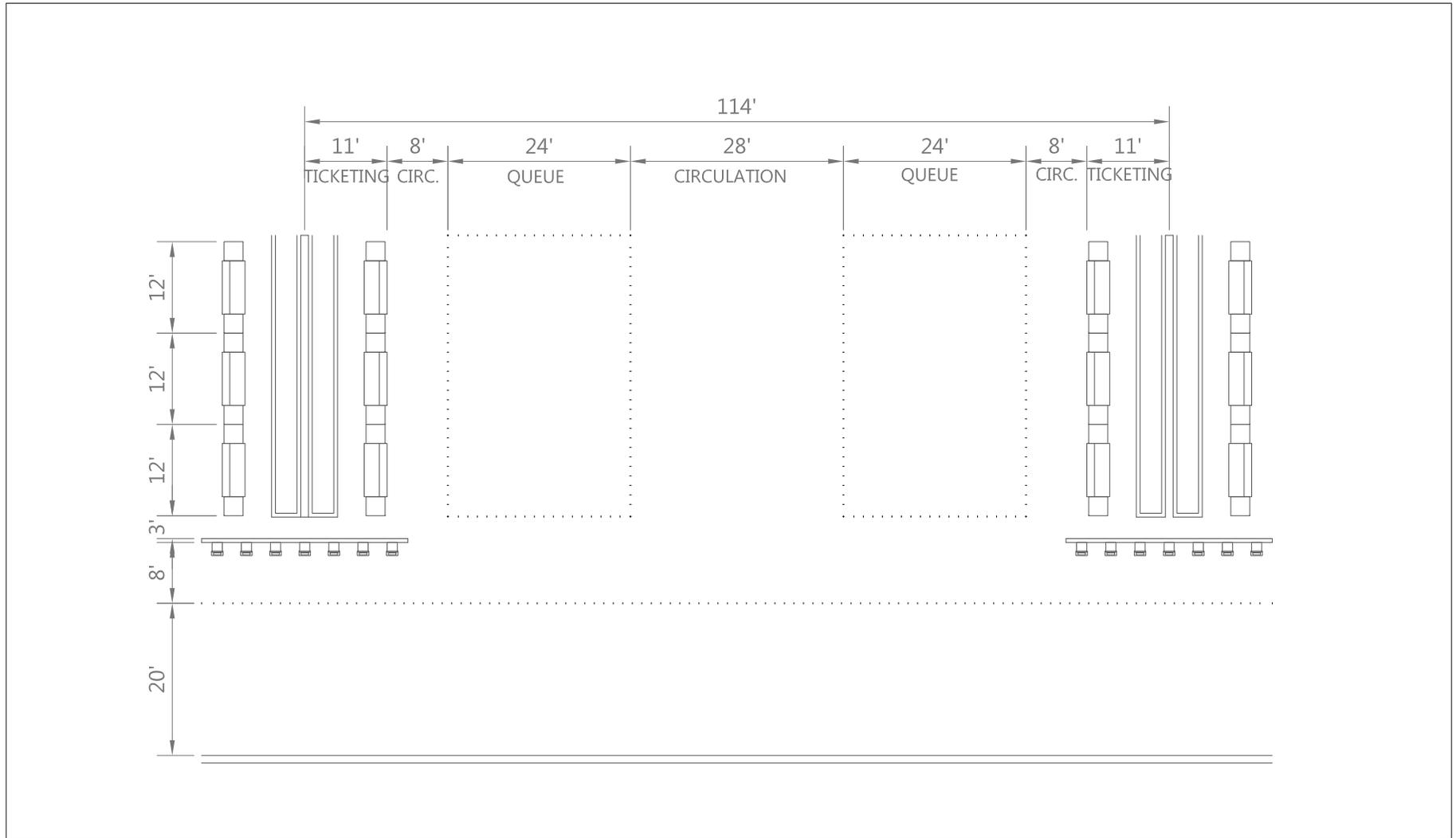
EXHIBIT 2-3



**LGA Terminal D - Delta Air Lines
Check-in Overlay**

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SOURCE: IATA ADRM, ACRP Report 25, June 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-4

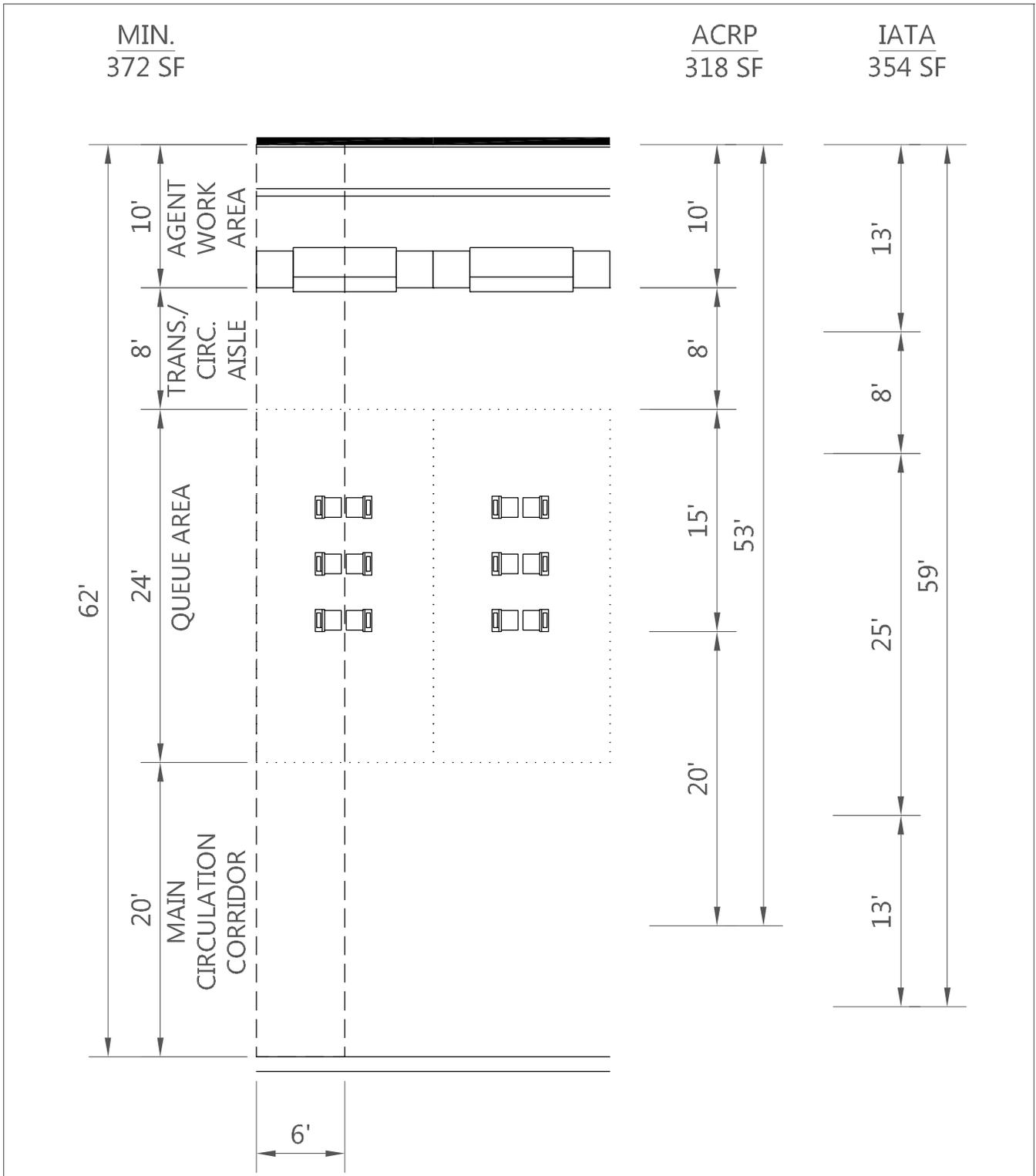


Check-In Benchmark Island Counter Configuration

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[Preliminary Draft for Discussion Purposes Only]



SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

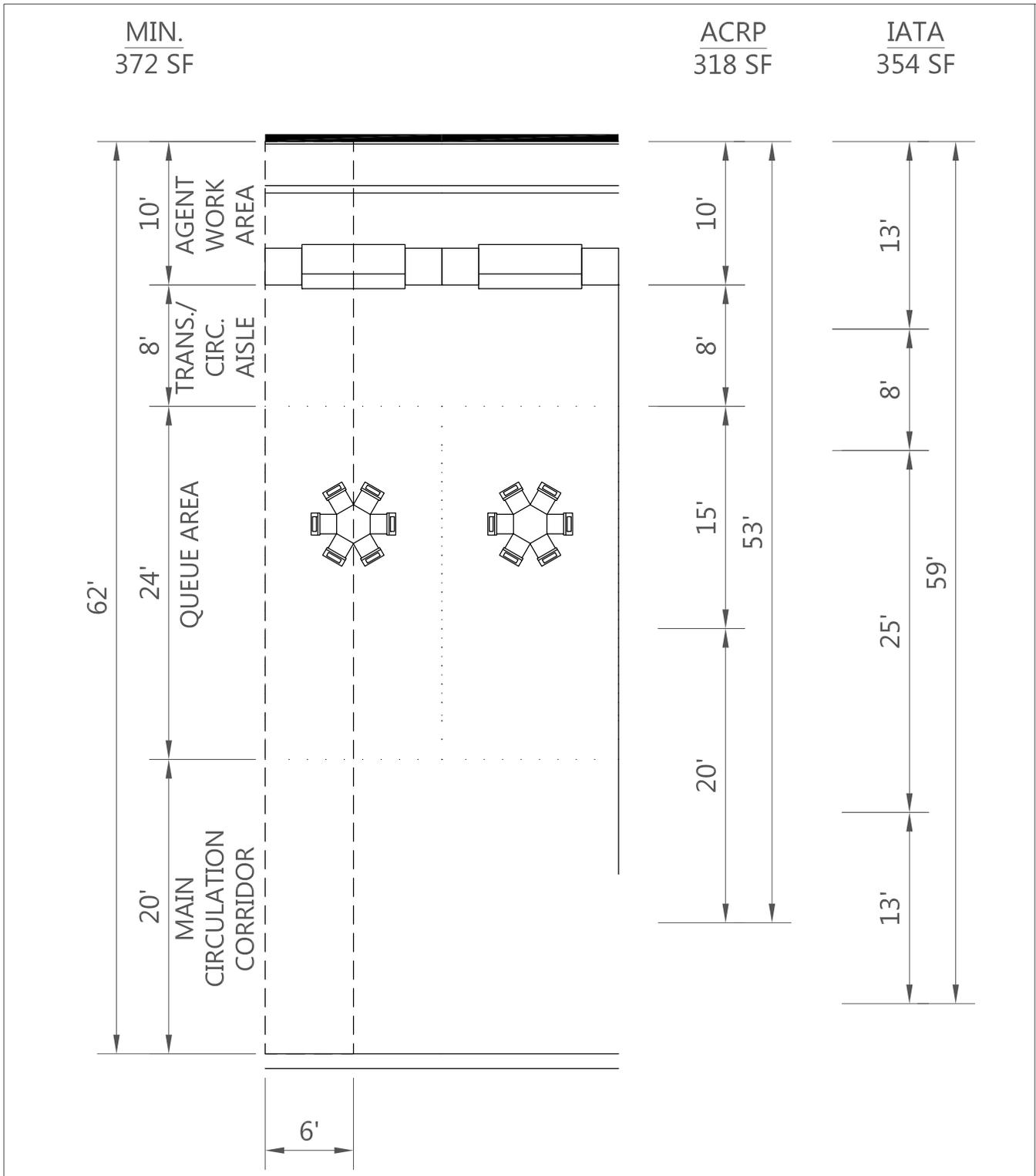
EXHIBIT 2-5



Check-In Benchmark Rectangular Kiosk Configuration

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SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

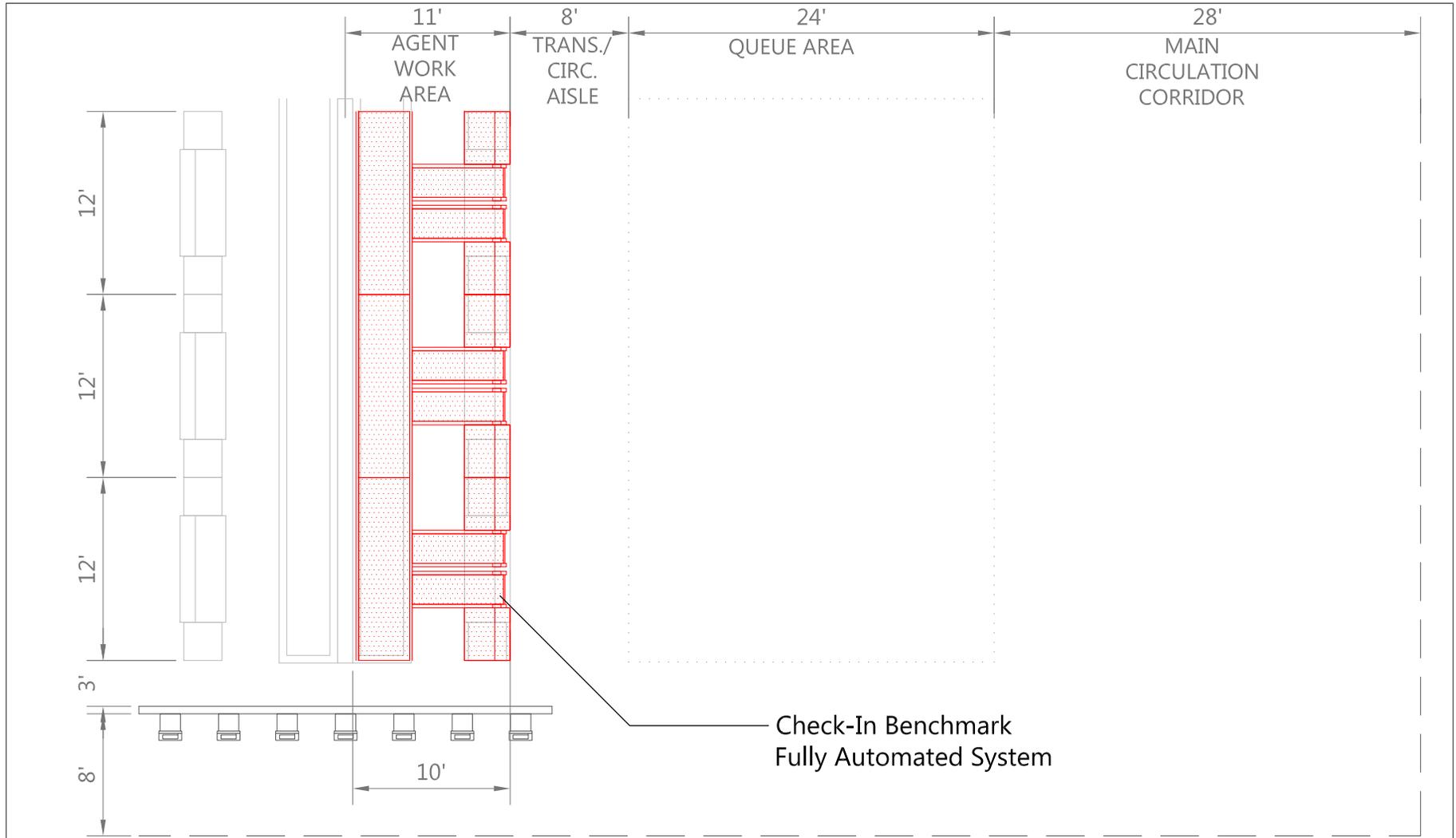
EXHIBIT 2-6



Check-In Benchmark Circular Kiosk Configuration

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SOURCE: IATA ADRM, ACRP Report 25, June 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

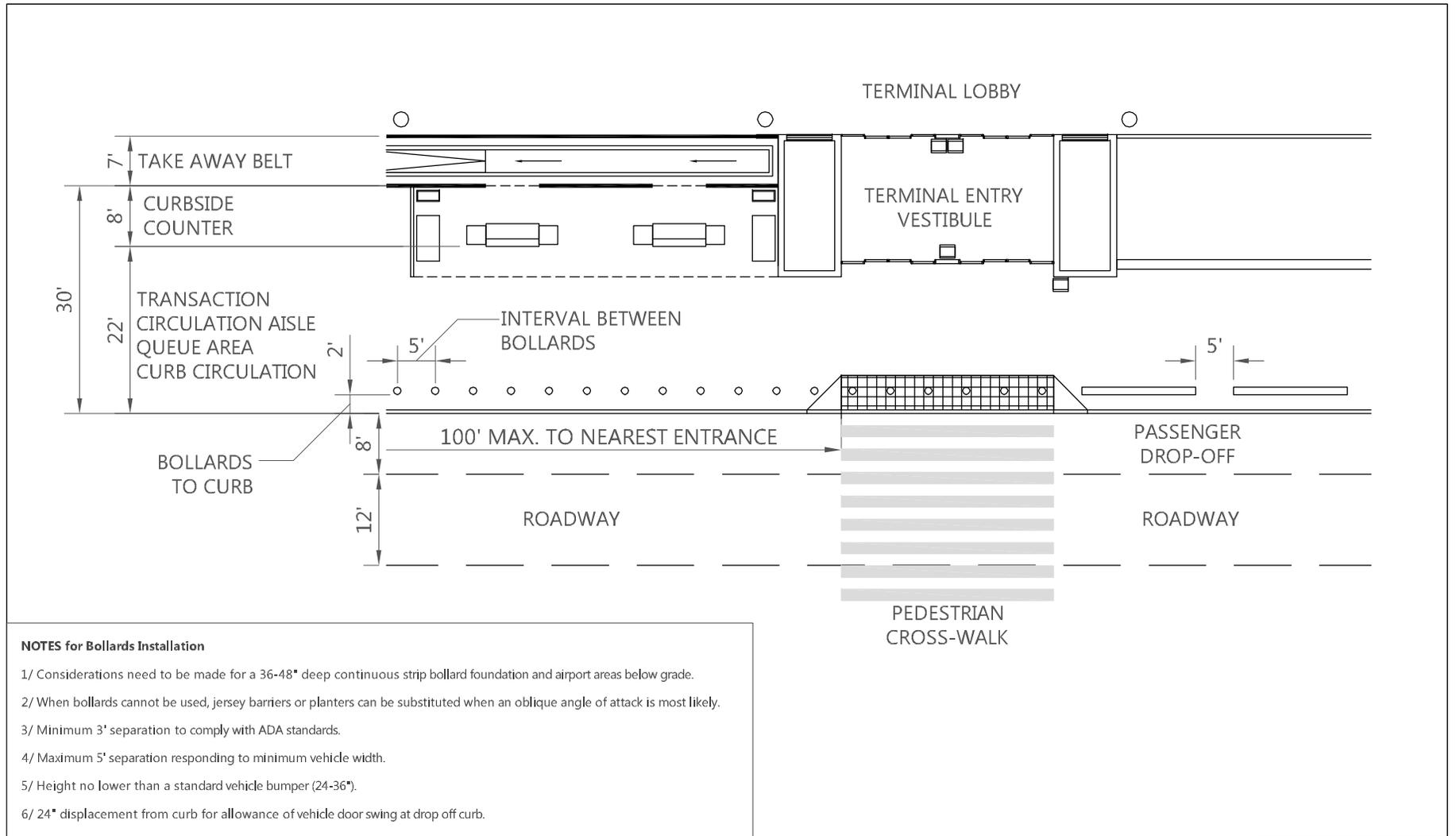
EXHIBIT 2-7



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Check-In Benchmark Fully Automated System

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SOURCE: FEMA 430: Site and Urban Design for Security, June 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-8



Check-In Benchmark
 Curbside

Drawing: N:\PANYNJ\Terminal Planning Guidebook\CAD\Curbside Check-in.dwg_Layout: Curbside_Aug 12, 2013, 2:13pm

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2.3 Passenger Security Screening Checkpoints

2.3.1 OVERVIEW

The TSA is responsible for screening all ticketed passengers and their carry-on baggage at security screening checkpoints prior to passengers entering secure gate boarding areas. Checkpoints have increased in complexity since formation of the TSA in 2002, and continue to evolve with new TSA regulations and directives designed to meet ever-changing security threats. Since 2002, the overall physical area requirements for checkpoint screening lanes and associated TSA support spaces have increased, even as screening regulations requiring the inspection of more materials and items of passengers' carry-on baggage have decreased screening lane throughput.

The physical characteristics of a terminal, passenger characteristics, and even seasonal changes affect screening lane throughput. The TSA issues a *Checkpoint Design Guide* (CDG) as a "living" document that is updated when the TSA adopts new technologies and policies. The CDG is adaptable to each unique airport and airport terminal building for reconfiguring existing checkpoints to meet current design guidelines, or locating and sizing new checkpoint(s) at an airport.

Trends and Innovations

Since the TSA was formed, the operation and appearance of security screening checkpoints have evolved several times. Notwithstanding these changes, the TSA has been consistent in its efforts to develop methods to separate risk levels by gaining prior knowledge of passengers before their arrival at the checkpoint. The trend is toward enrollment programs that provide the TSA the ability to assess risk related to passengers who voluntarily participate prior to their arrival at the airport checkpoint to expedite their screening. TSA Pre✓™ is the current manifestation of the risk assessment and expedited screening program. The implications for terminal planning are that expedited screening requires dedicated lanes that can only be used by selected participants, which consequently reduces overall terminal screening capacity if screening lanes used for the general public are reassigned to an enrollment program. Several other trends should be noted:

- Constrained funding for TSA programs limits its hiring and staffing capacity and is problematic for terminal development as the addition of screening lanes does not assure their staffing.
- Divest requirements and the sequential inline process used to reconcile threats identified using x-ray machines are critical determinants of overall throughput. TSA Pre✓™ expedites screening by eliminating nearly all forms of divest for approved passengers, whereas, for most other screening processes, the number of items that need to be removed from carry-on bags continues to increase the time needed to divest items and the number of separate items that need to be screened by x-ray machines. To address constraints posed by requirements to divest, several airports have extended surfaces to increase the numbers of passengers able to divest simultaneously.
- Document simplification and increased use of near field communication devices will automate passenger identity verification at checkpoints and be used to perform multiple identity and documentation processes, including visitor (non-U.S. citizen) departure records. Automated identity

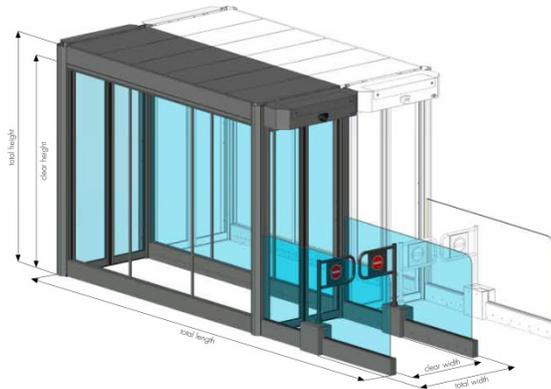
document validation for departing passengers is gaining acceptance outside the United States; the U.S. Customs and Border Patrol (CBP) Global Entry program is an example of automated identity verification programs adopted worldwide that are demonstrating the reliability of biometric embedded identifier chips in passport documents.

- Real-time queue management solutions are being used to manage and measure checkpoint performance and to improve passenger experience by communicating wait times to assist passengers in identifying their fastest screening option. The innovative use of Bluetooth and closed-circuit television to provide direct measurement of area occupancy is already being implemented at airports as a means to internally measure/track performance and to provide information to departing passengers through airport and social media websites.
- TSA prototype solutions, such as Future Attribute Screening Technology Mobile Module (FAST M²), are providing mobile platforms for research, development, and integration of new behavior/physiological-based screening methods for use in the field. The prototype solution aims to create free-flow screening by incorporating behavior screening techniques to improve user experience and throughput. FAST M² integrates multiple screening technologies to screen passenger behavior and physiological cues, such as hostile intent, cardiovascular/respiration, eye/body movement, and face/body gestures, in real time to determine threat level.
- Constrained funding for TSA programs will increase the responsibility of airport operators to secure controlled access points. Specifically, monitoring passenger exits from secure concourse areas, previously considered an element of the security checkpoint when exits are adjacent to a checkpoint, is being interpreted as an access control location by the TSA. The implication for terminal planning will be a need to determine comparative benefits and costs between using staffing or other physical means, such as revolving or interlocking doors, to prevent unauthorized access at these locations; the latter methods introduce exit capacity limitations related to door cycles and, in some cases, will require alternate access for personnel authorized to enter these locations, including federal air marshals. See **Figure 6** and **Figure 7** for example images of breach control doors.

Figure 6: Flip Flow Doors



SOURCE: www.record-usa.com, (http://www.record-usa.com/en/30_products/00_products.htm?catid=8&groupid=13), Accessed June 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

Figure 7: Flip Flow Doors Dimensions

SOURCE: www.record-usa.com, (http://www.record-usa.com/en/30_products/00_products.htm?catid=8&groupid=13), Accessed June 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

Supplemental References

- Transportation Security Administration, *Recommended Security Guidelines for Airport Planning, Design and Construction*, May 1, 2011, Part III, Section F.

2.3.2 PROGRAMMATIC INFORMATION

Checkpoint requirements define the number of travel document checkers (TDC), number of checkpoint lanes, and amount of queue area required to support terminal activity. A checkpoint lane consists of a single or paired advanced imaging technology (AIT) and magnetometer, x-ray unit with attached divest and recompose rollers and tables, manual search stations, and benches. A supervisor station is used to monitor each checkpoint area.

Demand is affected by the upstream flight check-in process. Performance criteria are applied to activity (demand) to determine the number of TDC and screening lanes needed. Dimensional criteria based on level of service criteria and operating requirements are then applied to the required numbers of TDC and screening lanes, and the numbers of passengers in transaction waiting areas (queues) to derive the initial space program.

For purposes of detailed planning, separate analyses would have to be conducted for each checkpoint, considering differences in any upstream processes that determine passenger flows into the checkpoint. Separate checkpoint requirements would be aggregated to formulate the overall program requirement for checkpoints.

Critical information necessary for calculating checkpoint requirements includes:

- Operating parameters
 - Staffing and operating hours
 - Utilization (general versus program lanes)
 - Processing rates
- Demand basis reflecting upstream processors
- Level of service criteria
- Dimensional criteria (space template)

Overall screening lane processing rates, typically stated in terms of passengers per hour per lane are measured by identifying the total number of passengers passing through the AIT or magnetometer. However, multiple processes within the screening process affect overall throughput. The TSA requires that each passenger pass the following screening procedures in sequence to complete checkpoint screening: ticketing (boarding pass and passenger identification) document check, divesture of TSA regulated items, AIT or magnetometer scans, recompose, and, if necessary, secondary screening (carry-on baggage and passenger search, or private personal search room screening). Processing rates at checkpoints vary based on airport, passenger characteristics, and time of year and should be considered in determining the processing rate to be used in determining the number of checkpoint lanes and the size of required areas.

Divest and recompose are the most time-consuming processes, and are the critical determinants of throughput. TSA regulations for divesting personal items require the use of multiple bins per passenger; similarly, passenger recompose activity—post AIT/magnetometer scanning—can extend the throughput of the x-ray units. Lack of adequate divest and recompose table lengths impede materials reaching the x-ray units, resulting in decreased lane throughput. Extension of divest and recompose table lengths at busy airports, such as Hartsfield-Jackson Atlanta International Airport, has yielded above-average processing rates.

Level of Service and Spatial Planning Guidelines

Checkpoint demand is analyzed against level of service standards that address performance in terms of the time passengers wait for processing and the space allotted each waiting passenger. The IATA LOS guidelines for checkpoint (same as passport control outbound) wait times are:

- Short to acceptable: 0-5 minutes
- Acceptable to long: 5-10 minutes

Table 2-3 lists the IATA space standards for passengers waiting in a single queue to be screened.

Table 2-3: IATA Level of Service Space Standards for Security Screening Checkpoints

	A	B	C	D	E	F
Checkpoint (IATA Passport Control) in square feet per passenger	15.0	12.9	10.8	8.6	6.5	<6.5

SOURCE: IATA ADRM, 9th Edition, Effective January 2004.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

The supply of screening lanes should be calculated to achieve the longest acceptable IATA standard of 10 minutes; however, queue areas should be planned to accommodate up to 20 minutes of accumulated passengers waiting for TDC screening to account for fluctuations in staffing. **Figure 8** provides the formula for calculating queuing area allowances based on wait time. The dimensional effects from extended queue depths on a checkpoint lane pair range from approximately 3,870 square feet to 4,860 square feet, depending on processing rates.

Figure 8: Checkpoint Queuing Area Wait Time Capacity

$$\text{Wait Time (min)} = \frac{\text{Total Queue Area (sf)}}{\text{LOS (sf/pax)}} \times \text{Screening Lane Throughput (min/pax)}$$

$$\text{Wait Time (min)} = \frac{315 \text{ sf}}{10.8 \text{ sf/pax}} \times 0.4 \text{ (min/pax)} = 12 \text{ min}$$

The acceptable amount of time that passengers wait for service coupled with transaction times are the primary factors determining the supply of TDC and checkpoint lanes needed and the number of passengers in queue. Space allowances for each passenger in queue are applied to the number of passengers in queue to calculate the minimum area required for queuing.

Dimensional Guidelines

The TSA does not provide guidance on level of service duration or spatial guidelines for wait times and area per passenger while in queue; however, it does indicate minimum area allocations for each checkpoint screening lane and associated support spaces. The TSA recommends a minimum of 300 square feet of queuing area per screening lane. TSA CDG recommends that airport planners and local TSA authorities collaborate to establish acceptable goals for airport-terminal-specific wait times and screening lane processing rates for planning purposes. The dimensional guideline for a checkpoint lane pair with AIT and magnetometer is approximately 3,870 square feet, as illustrated on **Exhibit 2-9**, consisting of:

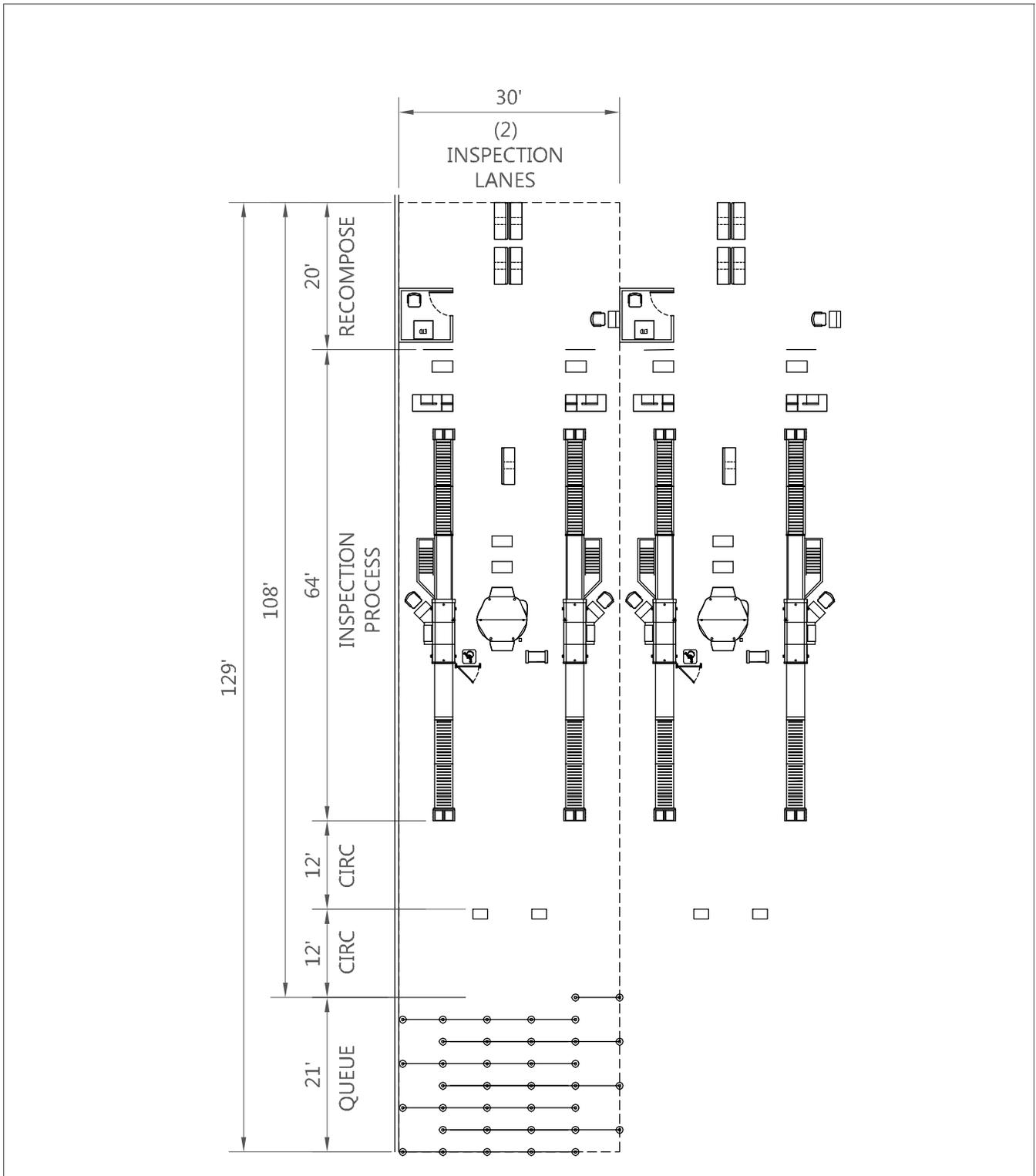
- Screening lane pair consisting of the length of each screening lane, including divest tables, x-ray machine, agent work area, recompose tables, AIT body scanner, magnetometer, divest bins, recompose benches
- Private search rooms, manual carry-on baggage search tables, and screening equipment
- Circulation aisle separating the screening lane area from the boarding pass document check agent podium
- Queue stanchions
- Stanchions for ADA-accessible and family queue lanes

Dimensional Derivatives

The configuration of existing terminals may limit the ability to add checkpoint lanes (laterally) to accommodate changes in demand. However, if terminal lobby depth is available, existing checkpoint lanes may be modified to provide more queuing capacity and add more divest tables to increase throughput. The dimensional guidelines for an expanded checkpoint lane pair with AIT and magnetometer can range from 4,680 square feet to 5,670 square feet, as illustrated on **Exhibit 2-10**.

Supplemental References

- IATA ADRM:
 - Chapter F, Section 9.3, “Passport Control”
 - Chapter F, Section 9.8, “Maximum Queuing Time”
- Transportation Security Administration, *Recommended Security Guidelines for Airport Planning, Design and Construction*, May 1, 2011, Part III, Chapter F.



SOURCE: Transportation Security Administration, Checkpoint Design Guide (CDG), Revision 3, March 10, 2011, June 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

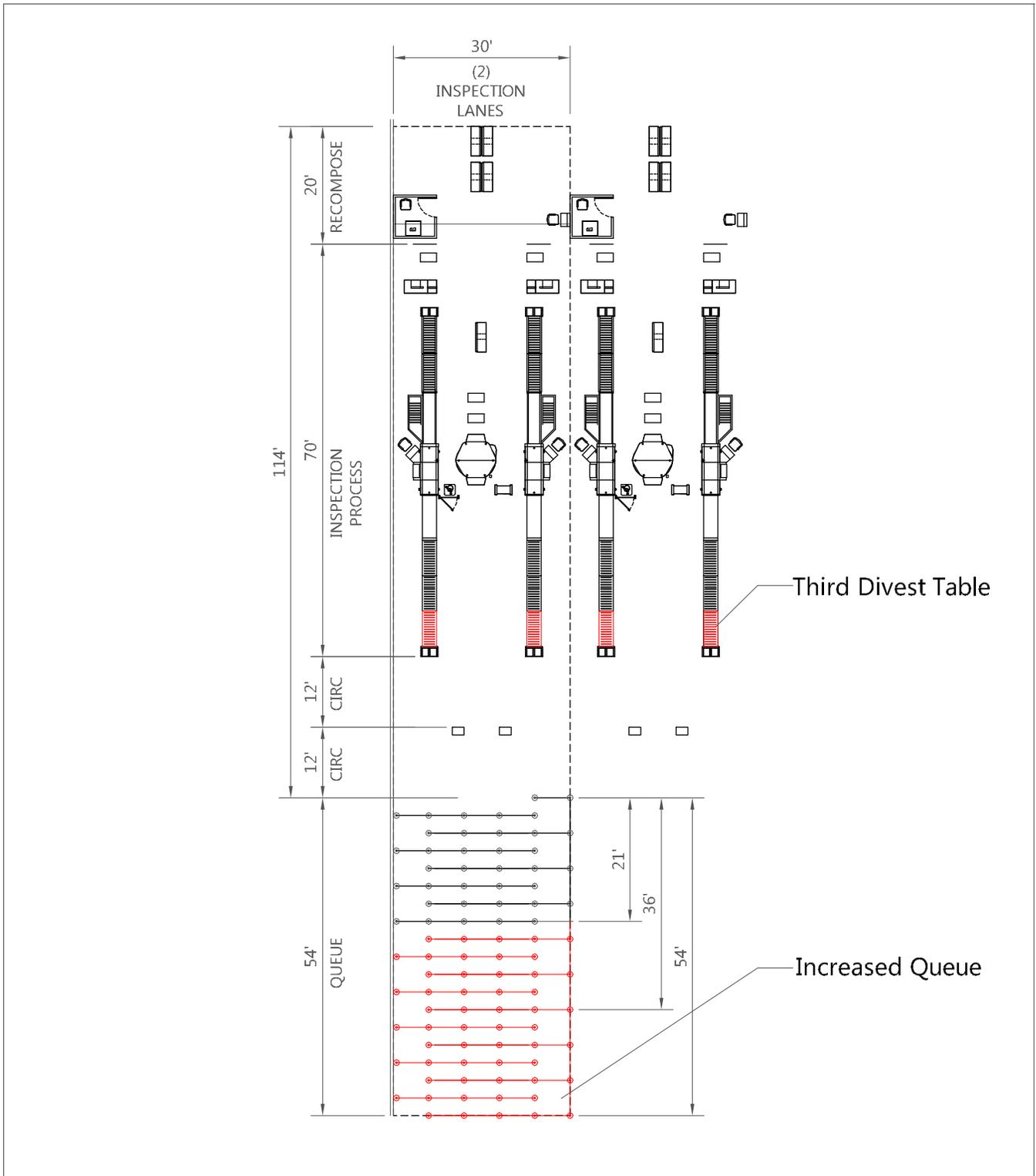
EXHIBIT 2-9



TSA CDG Checkpoint Benchmark

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SOURCE: Ricondo & Associates, Inc, August 2013.
PREPARED BY: Ricondo & Associates, Inc, August 2013.

EXHIBIT 2-10



TSA Checkpoint - Expanded

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2.4 Terminal Outbound Baggage Makeup Facilities

2.4.1 OVERVIEW

Outbound baggage makeup facilities are used by the airlines for storage, sortation, and loading of checked baggage onto baggage carts for delivery to departing aircraft. These facilities are located downstream of TSA baggage screening systems and are used for all originating passenger baggage and connecting passenger baggage not otherwise delivered directly between aircraft for domestic-to-domestic or domestic-to-international connections. Baggage transferred between international flights and subsequent connecting flights is required to be screened before being loaded onto the next aircraft.

Baggage is inducted into the conveyance system at different check-in locations, such as baggage drop locations and curbside check-in, and transported by conveyors to baggage screening systems. Cleared bags are then transported to the outbound baggage makeup areas by conventional conveyors or conveyance vehicles, such as linear (or chain) drive sorters and destination-coded vehicles. Contemporary outbound facilities use automated (centralized) sortation systems to distribute bags between separate baggage makeup devices. Older or smaller systems may lack automated sortation systems and centralized baggage screening systems, essentially operating as point-to-point (dedicated) systems. Automated sortation systems are able to deliver bags from a common (centralized) baggage screening facility to specific airline or flight baggage makeup devices. System capabilities, such as automated sortation, can affect terminal configurations, airline lease agreements, and operating policies. In most cases, automated systems provide terminal operators greater flexibility to support common-use facility arrangements.

The principal elements determining the size and arrangement of outbound baggage makeup areas are the:

- Type of makeup device: lateral presentation (or pier), chute presentation, or racetrack (carousel)
- Bag cart/tug staging (loading zones) and circulation aisles and lanes
- Control rooms and power cabinets
- Miscellaneous spaces for staff support (locker rooms and restrooms) and baggage handling system maintenance and storage

Although discussed separately in the Guidelines, offload areas for inbound (arriving) baggage are typically co-located with outbound baggage makeup areas.

Trends and Innovations

Innovations affecting outbound baggage makeup facilities are mostly related to intelligent systems and equipment installations that operate cleaner and faster and that are more energy efficient than older systems. Several important trends are occurring in the types of baggage flows being accommodated at terminals, including code sharing, early baggage storage, and remote check-in:

- Code-share agreements among airlines have increased the handling of transfer bags, which is more complex than handling originating bags. Code sharing allows participating airlines to use a common designator code (flight number) and sell tickets for a flight operated by another airline. Participating airlines synchronize their schedules and coordinate baggage handling to facilitate connections between flights; participating airlines share direct responsibility for passengers and their baggage connecting between flights. Terminals supporting hubbing airlines or airline alliances require capabilities to de-containerize bags (if presorted at the up-line (originating) airport, manually code bags, and inject bags into the automated sortation system, usually using a transfer load belt. The injection point into the sortation system relative to the baggage screening system depends on the international baggage recheck operation and its capabilities for screening rechecked bags.
- Operators of terminals that experience a large volume of originating or transfer bags more than 2 hours ahead of flight departure are beginning to use early baggage storage systems. Outside the United States, early baggage storage systems are increasingly used at large international airports to handle early arriving bags more economically than handling these bags within a space-constrained outbound baggage makeup facility, providing a more secure environment for storing early arriving bags. Early baggage storage systems can be co-located or separate from the outbound baggage makeup area, and operate manually with low baggage volumes or be fully automated.
- The operators of most large airports envision opportunities for remote (from terminal) check-in, including airport intermodal centers, rail stations, hotels, and downtown population centers. Remote check-in entails a baggage collection area remote from the terminal, transfer to a baggage screening area, and subsequent injection of the baggage into the outbound baggage makeup facility sortation system.

Supplemental References

- IATA ADRM:
 - Section U2.12, "Sortation Systems"
 - Section U3, "Transfer Systems"
- ACRP Report 25, Vol. 1: *Guidebook*
 - Section VI.3.12.1, "Baggage Make-up"
 - Section VI.4.1.2, "Outbound Baggage Systems"

2.4.2 PROGRAMMATIC INFORMATION

Outbound baggage makeup requirements define the amount of space needed to accommodate the types and number of baggage makeup devices (laterals, chutes, or carousels) and operational, vehicular, and staff support areas required to support terminal activity. Presentation length, which equates to the number of carts staged around a device for a flight during baggage makeup, and bag cart/tug circulation lanes represent the largest components of the space requirement and determine the dimensional criteria. Baggage makeup for a flight usually begins at the time agents at check-in counters begin to accept bags for a flight departure and ends when the flight is closed out.

For purposes of detailed planning, separate analyses should be conducted for each airline operating from the terminal, and differences in operating parameters and passenger characteristics among the airlines should be considered. Individual airline requirements should be aggregated according to rules for terminal facility use (exclusive, preferential or shared) to formulate the overall program requirement for outbound baggage makeup. Information used to develop outbound baggage makeup requirements include:

- Operating parameters
 - Rules for use: flight sector, duration for baggage makeup by flight sector and aircraft type, close out time, use/lease basis, transfer bag handling
 - Baggage system equipment
- Demand basis
 - Planning schedule analyses by airline to determine aircraft or reasonable equivalent aircraft for baggage make-up.
 - Number and rate of checked bags per flight received from upstream processes.
- Dimensional criteria (space template)

Outbound Baggage Makeup – Dimensional Guidelines

The dimensional guidelines for typical outbound baggage makeup carousels and ancillary circulation rights-of-way are illustrated on **Exhibit 2-11** (showing parallel cart staging) and **Exhibit 2-12** (showing perpendicular cart staging); and on **Exhibit 2-13** for typical makeup piers. The guidelines address:

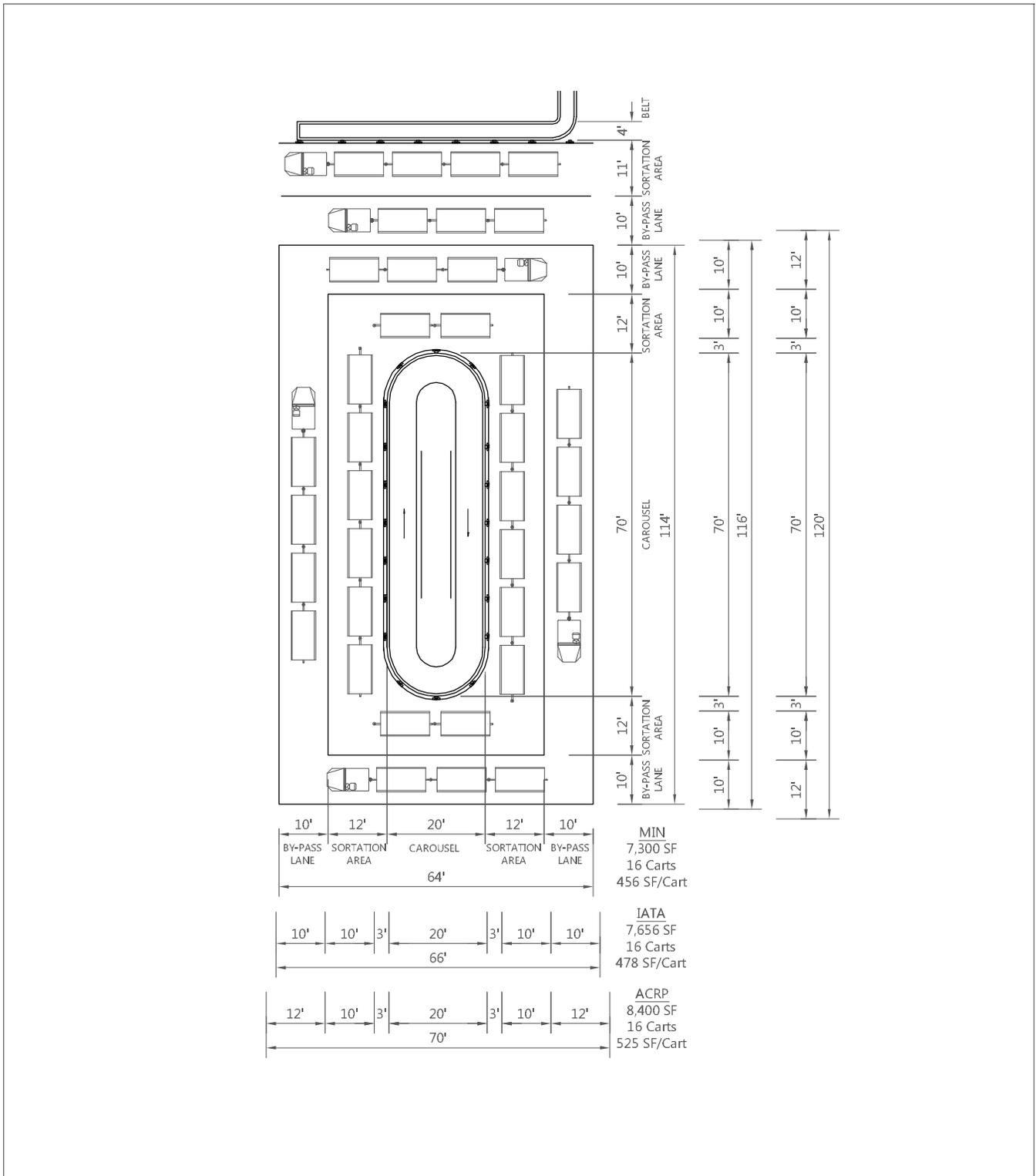
- Makeup device presentation length
 - Cart staging
 - Sortation area (loading aisle and cart/container staging area),
- Tug bypass lane

Minimum floor-to-floor head clearances should be maintained in baggage handling facilities for tug cart circulation, conveyors, and other building systems' equipment rights-of-way. These minimum clearance recommendations are illustrated on **Exhibit 2-14**, which indicates:

- Tug cart clearance from the finish floor to the underside of a fixed structure element or conveyor belt system
- Baggage conveyance line clearances from the bottom of the structure to the bottom of the conveyor belt

Supplemental References

- IATA ADRM, 2004:
 - Chapter U, Section 2.12, "Sortation Systems"
 - Chapter U, Section 3, "Transfer Systems"
- ACRP Report 25, Vol. 1: *Guidebook*, 2010.
 - Chapter VI, Section 3.12.1, "Baggage Make-up"
 - Chapter VI, Section 4.1.2, "Outbound Baggage Systems"



SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
 PREPARED BY: Ricondo & Associates, Inc, August 2013.

EXHIBIT 2-11

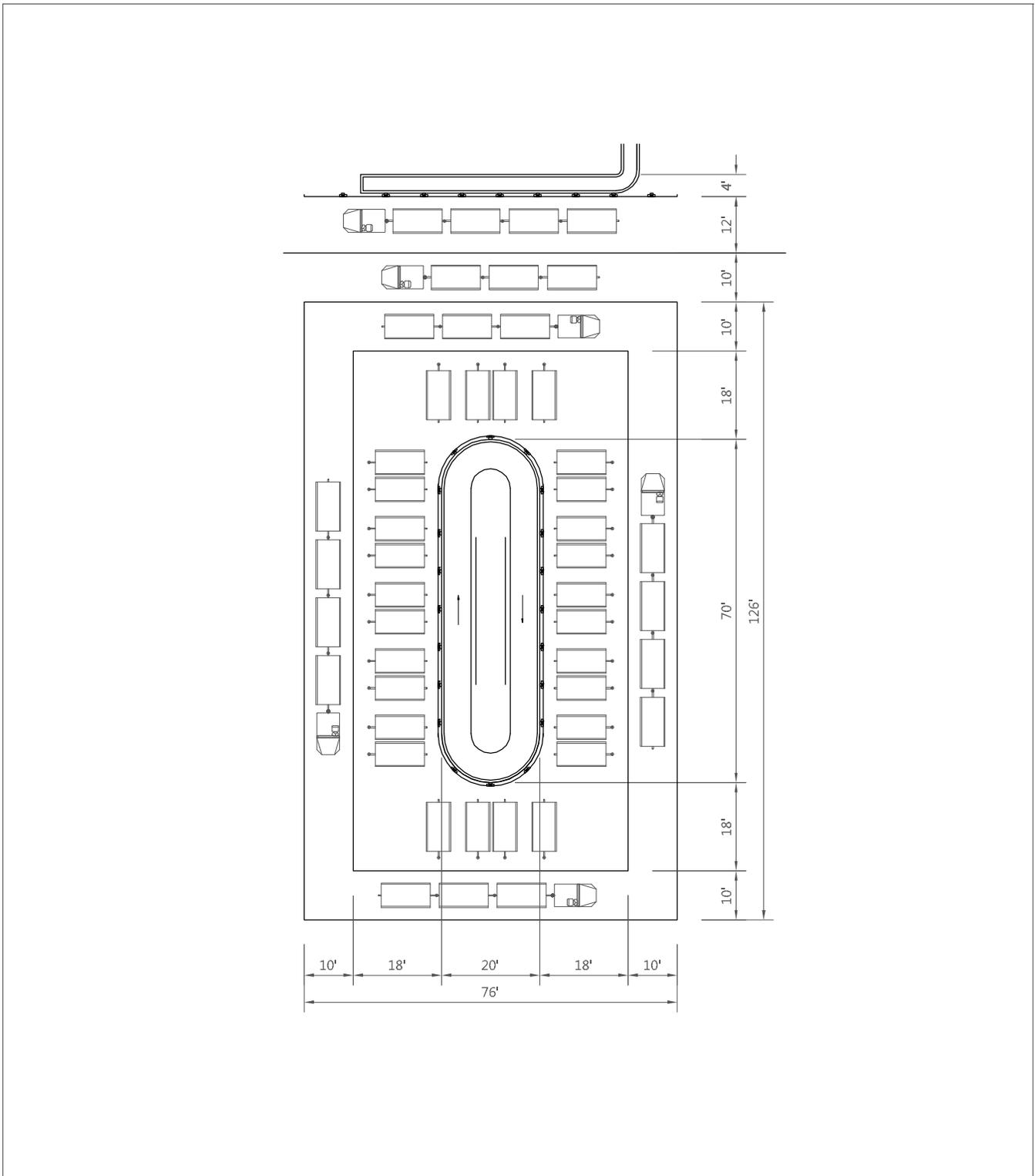


Outbound Bag Make-Up Benchmark Parallel Staging

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[Preliminary Draft for Discussion Purposes Only]



SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
PREPARED BY: Ricondo & Associates, Inc, August 2013.

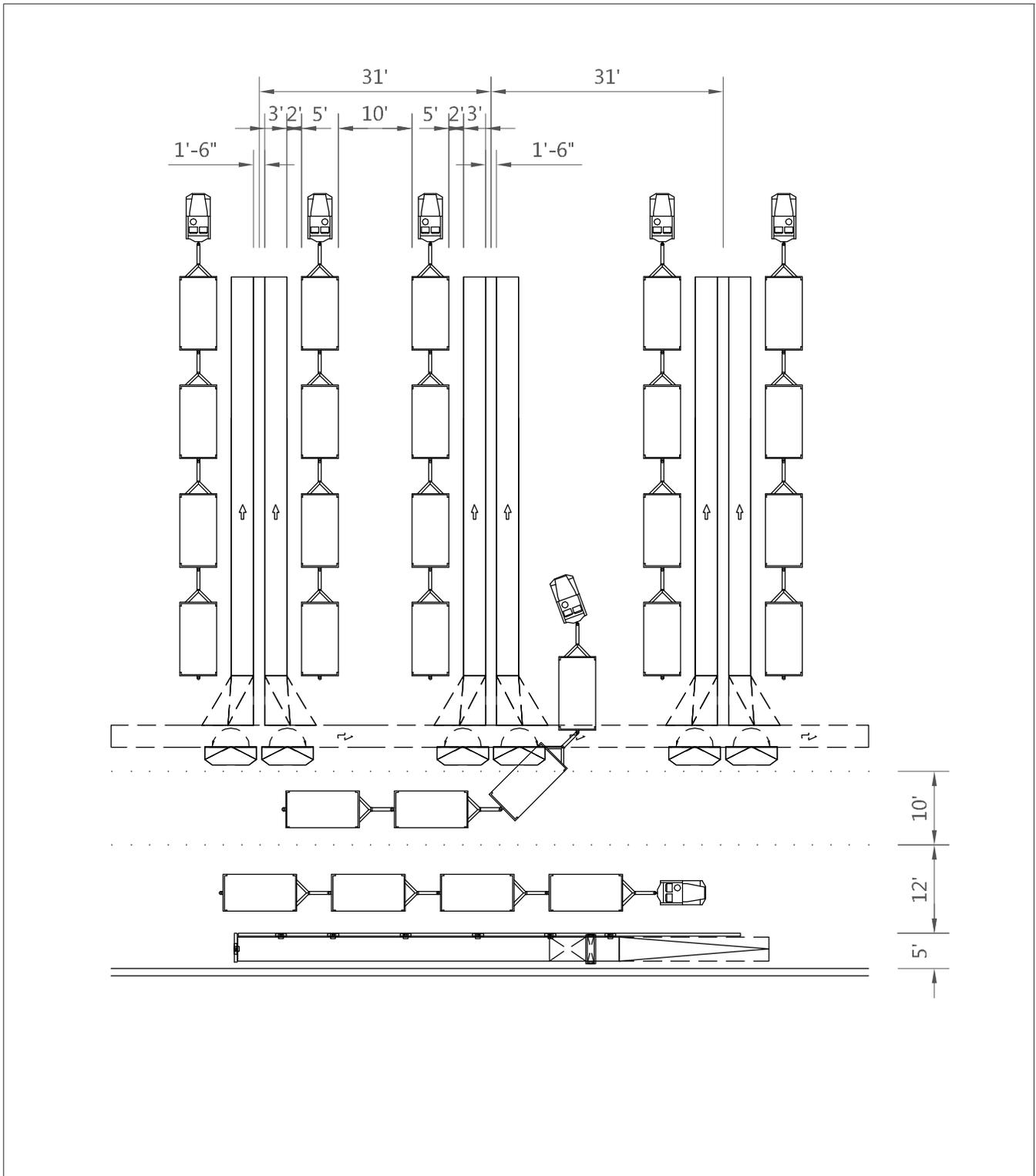
EXHIBIT 2-12



Outbound Bag Make-Up Benchmark Perpendicular Staging

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SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-13

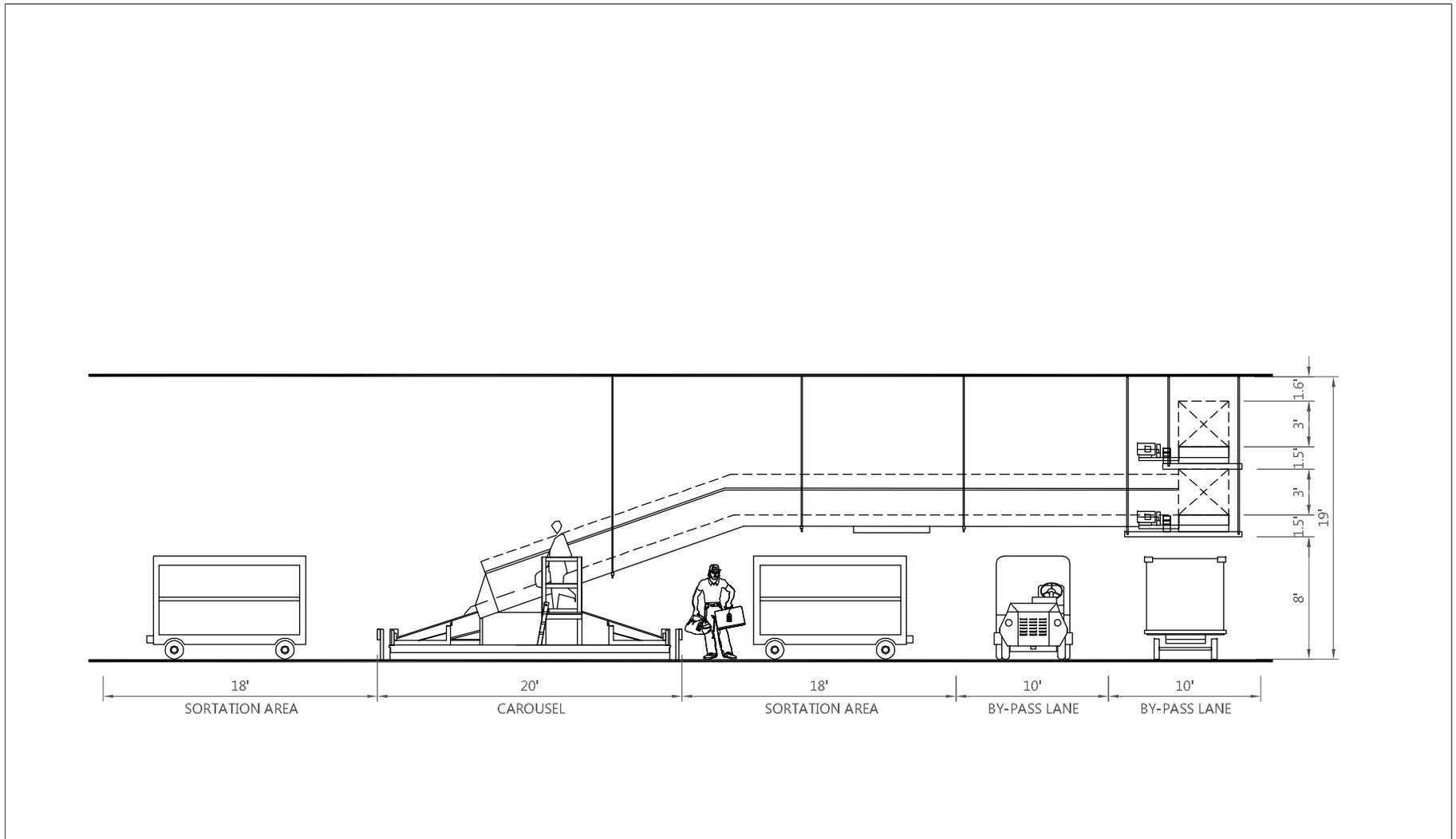


Outbound Bag Make-Up Benchmark Pier Configuration

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[Preliminary Draft for Discussion Purposes Only]



SOURCE: IATA ADRM, ACRP Report 25, June 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-14

Outbound Bag Make-Up Benchmark Height Clearances



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2.5 Preboarding Areas

2.5.1 OVERVIEW

Preboarding areas addressed in these Guidelines refer to terminal components located post-security screening checkpoints that are principally used by passengers prior to boarding aircraft. These components are intentionally grouped together herein for discussion purposes to reinforce the Port Authority's desire to provide passengers a seamless, free-flowing experience between the security screening checkpoint and the departure gate. These components include:

- Departure lounges (holdrooms) for passengers waiting to board aircraft, including seating and standing areas, airline service counter and gate check podium, and egress aisle from the boarding gate.
- Considerations for concession seating areas in the context of holdroom level-of-service criteria and capacity.
- Public corridors and restrooms.

Trends and Innovations

The terminal experience for most passengers has evolved into two parts: pre- and post-security screening. The area pre-security is mostly characterized by uncertainty regarding queuing and processing times at the checkpoints, whereas, after clearing security, passengers experience less stress and are more likely to spend discretionary time before or between flights on value-added services. ACRP Report 54 notes that passenger surveys at 10 airports indicated a range of total dwell time between 83 minutes and 65 minutes, of which an average of 60 percent of the time was spent post-security. In other words, for these 10 airports, passengers completed all processing except boarding and, on average, had more than an hour to spend post-security. Recognizing the important contribution of non-aeronautical revenue to financial sustainability, terminal operators target locations for more than 70 percent of total in-terminal concession space post-security screening checkpoints.

The Port Authority *Airport Terminal of the Future* workshop described concourses as multifunctional, with the various functions seamlessly blended between physical and air space to address customer needs. The concourse of the future will be built on the principle of "process and enjoy," not "process and wait." Underpinning these principles were several priorities and key characteristics, as follows:

- Make people feel welcome.
 - Make the uncertain certain.
 - Compress the time for processing and increase the time for enjoyment.
 - Actively communicate through messaging, mobile devices, enhanced wayfinding, etc., and provide the ability for passengers to see the aircraft to provide time-certain distance to the departure gate.
- Provide diverse services catering to passenger (customer) segmentation.

Characteristics that traditionally define holdrooms are evolving to allow multiple seating configurations (see **Figure 9** and **Figure 10**) and to integrate the concessions within visual connection to aircraft. IATA's current guideline suggests that 25 to 40 percent of seating provided in airside restaurants and food courts can be counted as contributing to available airside seating. Airlines are increasingly organizing boarding calls and gate check queues that improve passenger certainty regarding the boarding process and reduce their time in holdrooms.

Figure 9: Gate 22, John F. Kennedy International Airport, Terminal 5



SOURCE: DY Consultants, August 2013.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Figure 10: Central Holdroom Concessions, John F. Kennedy International Airport, Terminal 5



SOURCE: DY Consultants, August 2013.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Technology, such as gate information display systems and airline mobile notifications, is increasing passenger certainty by providing anywhere/anytime access to flight status, and self-service gate-check systems using near field communication devices and bar code readers are reducing boarding times and improving priority access for certain passenger segments.

Supplemental References

- Port Authority of New York and New Jersey, *Airport Terminal of the Future Workshop - Notes and Highlights*, September 19, 2012
- ACRP Report 25, Vol. 1, *Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.5, "Concessions"*, 2010.
- ACRP Report 54, *Resource Manual for Airport In-Terminal Concessions*, Chapter I, Section 1.1, "Changes in Airport In-Terminal Concession Programs", 2011.
- ACRP Report 67, *Airport Passenger Conveyance Systems Planning Guidebook*, Chapter II, "Best Practices", 2012.
- IATA ADRM, Chapter J, Section 7.2, "Location of Retail Facilities", 2004.
- IATA, Copart, Stephan, *Fast Travel Program Strategy*, Revision 5, May 2012.

2.5.2 CONCOURSE PROGRAMMATIC INFORMATION

The overall concourse program is primarily dependent on the terminal aircraft parking arrangement and airfield infrastructure. In most cases, the linear frontage of the terminal airside component correlates to aircraft wingspans and wingtip clearances between aircraft. It is critical to maintain the integrity of the apron to accommodate changes in aircraft fleet mix and gating requirements. Concourses are single-loaded (gates on one side) or double-loaded (gates on both sides), and consist of holdrooms, concessions, restrooms, circulation corridors, and airline and airport support spaces. Dimensional criteria based on fleet mix, level-of-service criteria, and spatial guidelines for circulation corridor widths, holdrooms, restrooms, and concessions programs are then applied to derive the initial space program. Detailed programming for holdrooms and restrooms is discussed later in Sections 2.5.3 and 2.5.4, respectively.

For purposes of detailed planning, separate analyses would have to be conducted for each airline operating on the concourse, and differences in aircraft fleet mix among the airlines operating on the concourse would have to be considered. Individual airline requirements would be aggregated according to rules for terminal facility use (exclusive, preferential or shared) to formulate the overall concourse gate requirement. Information used to develop concourse gate requirements include:

- Demand basis
 - Largest aircraft using each gate and fleet mix
 - Turns per gate
 - Buffer time between gate turns

Concourse – Level of Service and Spatial Planning Guidelines

Level-of-service guidelines for concourse programming are primarily applied to public circulation corridors that connect all concourse elements, such as holdrooms and restrooms, which are programmed based on their specific level of service and operational criteria. Level-of-service criteria are applied to secure circulation

corridors to determine corridor width as a function of the concourse being single- or double-loaded and the presence of moving walkways. Factors in determining concourse circulation corridor width include:

- Single- or double-loaded concourse
- Moving walkways, determined on the basis of:
 - Walking distance between gates and concourse exit portals
 - Passenger demographics (i.e., aging population, passengers with disabilities)
- Percentage of passengers using the conveyance system

Concourse – Dimensional Guidelines

The dimensional guidelines for a concourse module are illustrated on **Exhibit 2-15**, which shows:

- A double-loaded concourse
- Moving walkways
- Holdrooms
- Restrooms
- Concessions

A concourse module is recommended to maximize gate capability to maintain flexibility in changes in aircraft fleet mix. IATA refers to various aircraft parking arrangements as a Multiple Aircraft Ramp System. Exhibit 2-15 illustrates a module for three Boeing 737-900 (Airplane Design Group [ADG] III) aircraft gates or single gates for Boeing 787-800 (ADG V) aircraft and Boeing 757-400 (ADG IV) aircraft, and holdrooms, concessions, and restrooms. The linear frontage of the concourse module is approximately 428 feet, defined by three Boeing 737-900 aircraft, which would accommodate a wingspan of 117.5 feet and wingtip clearances of 25 feet between each aircraft. The 104-foot-wide concourse module is established by a 44-foot central circulation corridor (dual moving walkways at 14 feet wide with 15 feet of circulation on both sides of the moving walkways) and flanked by 30-foot-wide holdrooms. Concourse circulation corridors are recommended in accordance with the minimum widths indicated in **Table 2-4**:

Table 2-4: Minimum Circulation Corridor Width (feet)

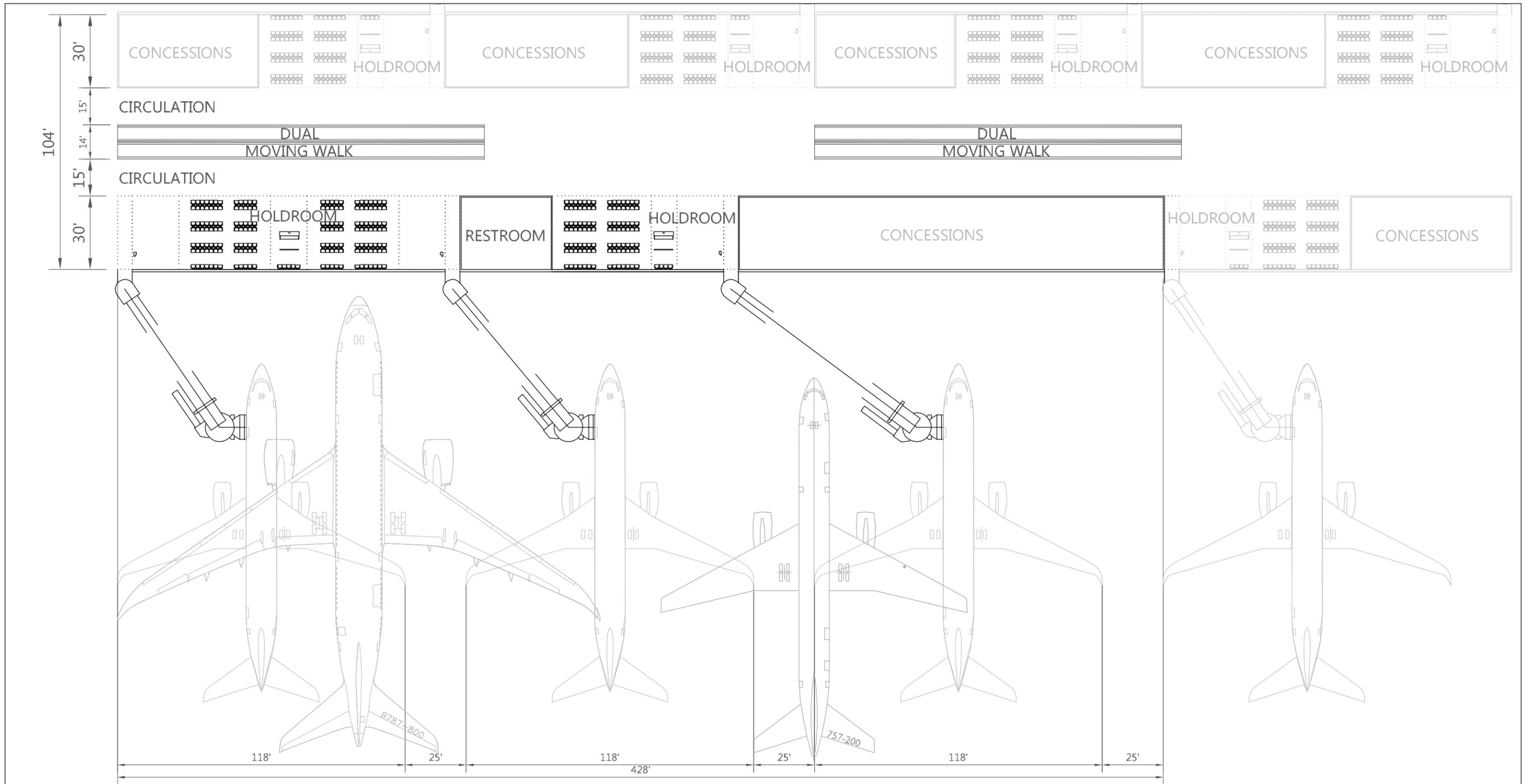
Circulation Corridor Width	CONCOURSE CONFIGURATION	
	Single Loaded Concourse	Double Loaded Concourse
No Moving Walkways (ft)	20	30
With Moving Walkways ¹ (ft)	30	30

Note:

1/ For concourses with moving walkways, 15 feet of circulation corridor width was assumed on both sides of the moving walkway; if the moving walkway is flush against a wall, then 30 feet of circulation corridor width should be provided adjacent to the moving walkway.

SOURCE: ACRP Report 25, *Airport Passenger Terminal Planning and Design*, Vol. 1, *Guidebook*: Section VI.3.10, "Circulation," 2010.

PREPARED BY: Ricondo & Associates, Inc., August 2013.



SOURCE: Ricondo & Associates, Inc., August 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-15



Concourse Module

Drawing: N:\PAN\NJ\Terminal Planning Guide\book\CAD\GateLayout.dwg_Layout: Concourse module (11x17)_Aug 12, 2013, 2:40pm

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The overall concourse width would increase if sterile corridors were required for international arrival operations at each gate. The width of the sterile corridor depends on the number of gates, vertical circulation, and control door system requirements served by the sterile corridor; planning and design would be coordinated with CBP design guidelines.

2.5.3 HOLDROOM PROGRAMMATIC INFORMATION

Within the concourse, holdroom area requirements define the amount of space needed to accommodate the waiting area, boarding and egress aisles, and agent counter for the largest aircraft occupying each gate throughout the planning flight schedule day. Dimensional criteria based on level-of-service criteria and spatial guidelines for holdroom depth, agent counter areas, boarding and egress aisles, and adjacency are then applied to the required waiting area to derive the initial space program.

For purposes of detailed planning, separate analyses would have to be conducted for each airline operating on the concourse, and differences in aircraft fleet mix among the airlines must be considered. Individual airline requirements would be aggregated according to rules for terminal facility use (exclusive, preferential or shared) to formulate the overall program requirement for holdrooms. Information used to develop holdroom requirements include:

- Demand basis (largest aircraft using each gate)
- Level of service criteria
- Dimensional criteria (space template)

Holdroom – Level of Service and Spatial Planning Guidelines

The Guidelines carry forth the minimum holdroom sizing standard from the Manual, last published in May 2005. The Port Authority standard is based on modified IATA holdroom guidelines for LOS C. The methodology for establishing holdroom areas considers the waiting area (for seated and standing passengers), number of agent check-in podiums, and gate boarding/egress aisles. However, conforming to IATA level of service criteria, 25 to 40 percent of seating provided in airside restaurants and food courts can be counted as contributing to available holdroom seating.

Holdrooms are sized based on the following factors:

- Largest aircraft type operating at the gate and number of seats
- 80% peak load factor
- Waiting areas determined by 60% of passengers assumed to be seated, and 40% assumed to be standing
- 15 square feet per seated passenger, and 10 square feet per standing passenger
- Addition of 230 square feet per gate agent podium, and 180 square feet per boarding/egress aisle
- A 10% reduction in waiting area can be credited for shared holdrooms

Table 2-5 provides an example of holdroom sizing to accommodate passengers on a narrowbody aircraft.

Table 2-5: Holdroom Sizing – Narrowbody Aircraft

	SINGLE GATE	SHARED GATES
Aircraft Seats (seats)	180	180
Load Factor (%)	80	80
Design Passengers (pax)	144	144
Passengers @ 60% Percent Seated (pax)	87	87
Passengers @ 40% Percent Standing (pax)	57	57
Seating Area @15 Square Feet per Passenger (sf)	1,305	1,305
Standing Area @10 Square Feet per Passenger (sf)	570	570
Holdroom Depth (feet)	30	30
Gate Agent Positions (ea)	2	2
Two (2) Gate Agent Podium (sf)	230	230
Boarding/Egress Aisle (sf)	180	180
Waiting Area ^{1/} (sf)	1,875	1,690
Total Holdroom Area (sf)	2,285	2,100

NOTE:

1/ Shared holdroom applies adjacency credit of 10% reduction in seating area.

SOURCE: Ricondo & Associates, Inc., May 2013.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Holdroom – Dimensional Guidelines

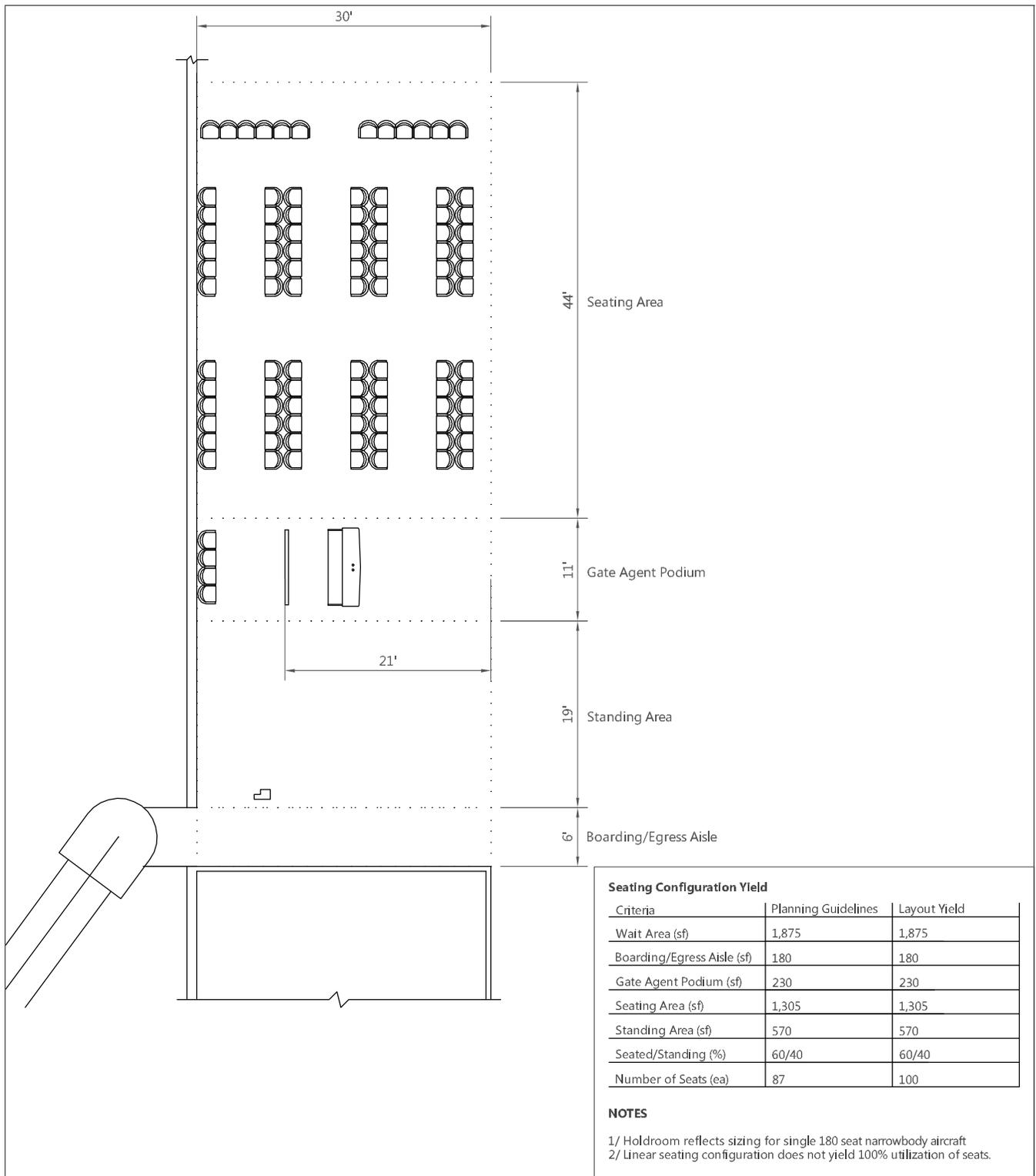
The dimensional guidelines for a typical holdroom are illustrated on **Exhibit 2-16**. A typical holdroom includes:

- Preboarding waiting area (seated and standing areas)
- Holdroom width
- Agent gate podium
- Boarding/egress aisles

In accordance with the Port Authority's holdroom design guidelines for a 180-seat aircraft, a total waiting area of 1,875 square feet is required, split between 60% for seated passengers (1,305 square feet and 87 seats required) and 40% for standing passengers (570 square feet). Exhibit 2-16 and **Exhibit 2-17** present comparisons of available seating and standing areas between linear and cluster seating holdroom configurations when furniture layouts are applied.

Exhibit 2-16 illustrates a holdroom with a linear seating configuration. Port Authority Guidelines require that 87 seats be provided in this configuration. After accounting for 5 feet of circulation between seats, 100 seats can be provided within the allotted seating area, complying with Port Authority holdroom design guidelines.

[Preliminary Draft for Discussion Purposes Only]



Seating Configuration Yield		
Criteria	Planning Guidelines	Layout Yield
Wait Area (sf)	1,875	1,875
Boarding/Egress Aisle (sf)	180	180
Gate Agent Podium (sf)	230	230
Seating Area (sf)	1,305	1,305
Standing Area (sf)	570	570
Seated/Standing (%)	60/40	60/40
Number of Seats (ea)	87	100

NOTES
 1/ Holdroom reflects sizing for single 180 seat narrowbody aircraft
 2/ Linear seating configuration does not yield 100% utilization of seats.

SOURCE: Port Authority of New York New Jersey Planning and Design for Terminals and Facilities, Airport Standards Manual, May 2005.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-16

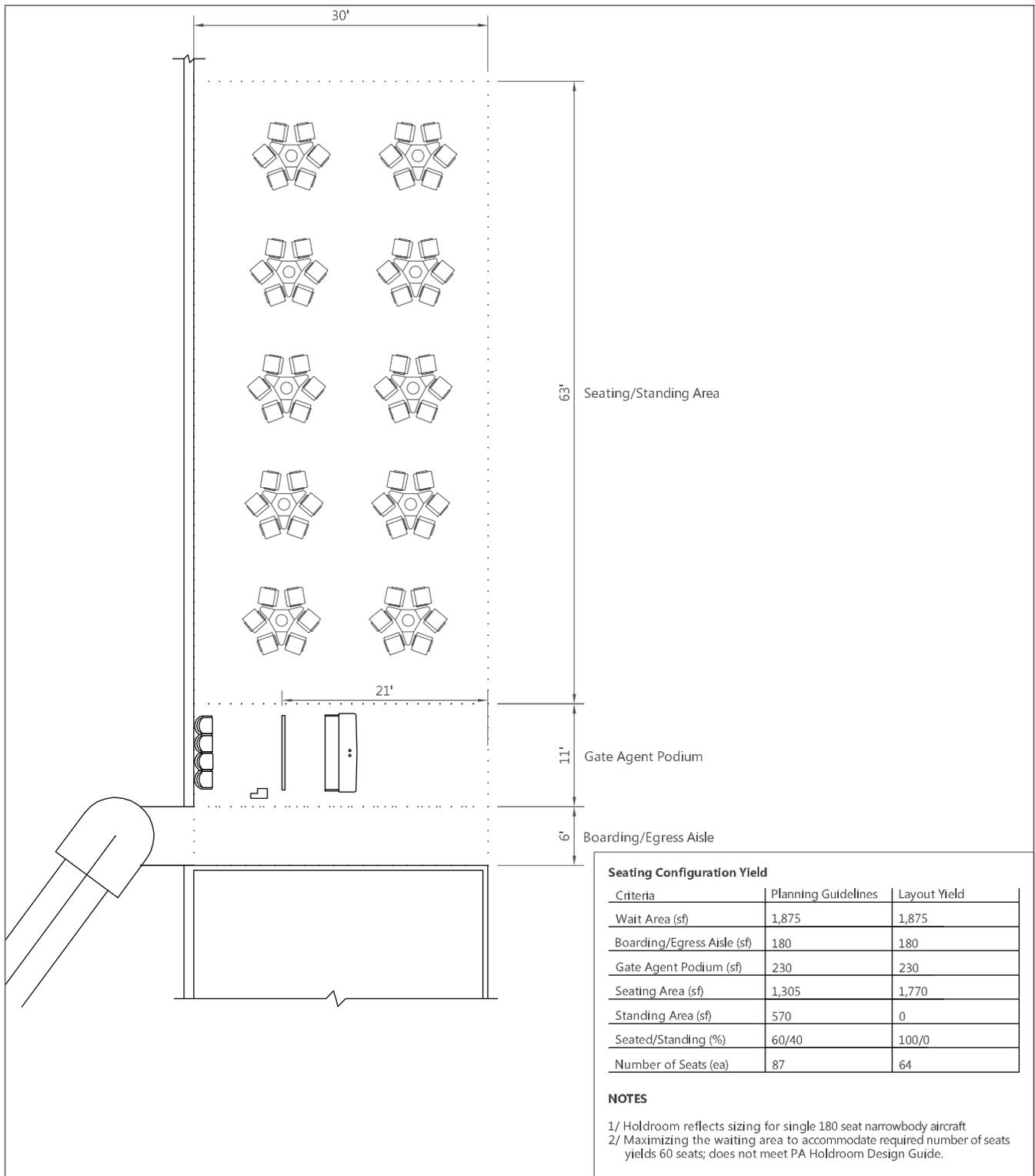


Narrowbody Holdroom Linear Seating Configuration

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[Preliminary Draft for Discussion Purposes Only]



SOURCE: Port Authority of New York New Jersey Planning and Design for Terminals and Facilities, Airport Standards Manual, May 2005.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-17



Narrowbody Holdroom Cluster Seating Configuration

Drawing: N:\PANYNJ\Terminal Planning Guidebook\CAD\GateLayout.dwg_Layout: Cluster Module_Aug 12, 2013, 2:51pm

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However, observations of passenger behavior in transportation waiting areas indicate that 100% of seats are rarely occupied when seats are arranged in a linear configuration. Passengers tend to sit in every other seat and place their carry-on baggage on empty seats to secure personal comfort space. Other seating arrangements, such as cluster seating in which seats are pointed out from the center, achieve a higher seat occupancy rate. Exhibit 2-17 illustrates that approximately 64 seats in a cluster configuration can be accommodated within the waiting area, which does not comply with Port Authority holdroom design guidelines. In this instance, no space is available for standing passengers, which can lead to standing passengers spilling into the central circulation corridor during the boarding process.

Holdroom – Derivative Layouts

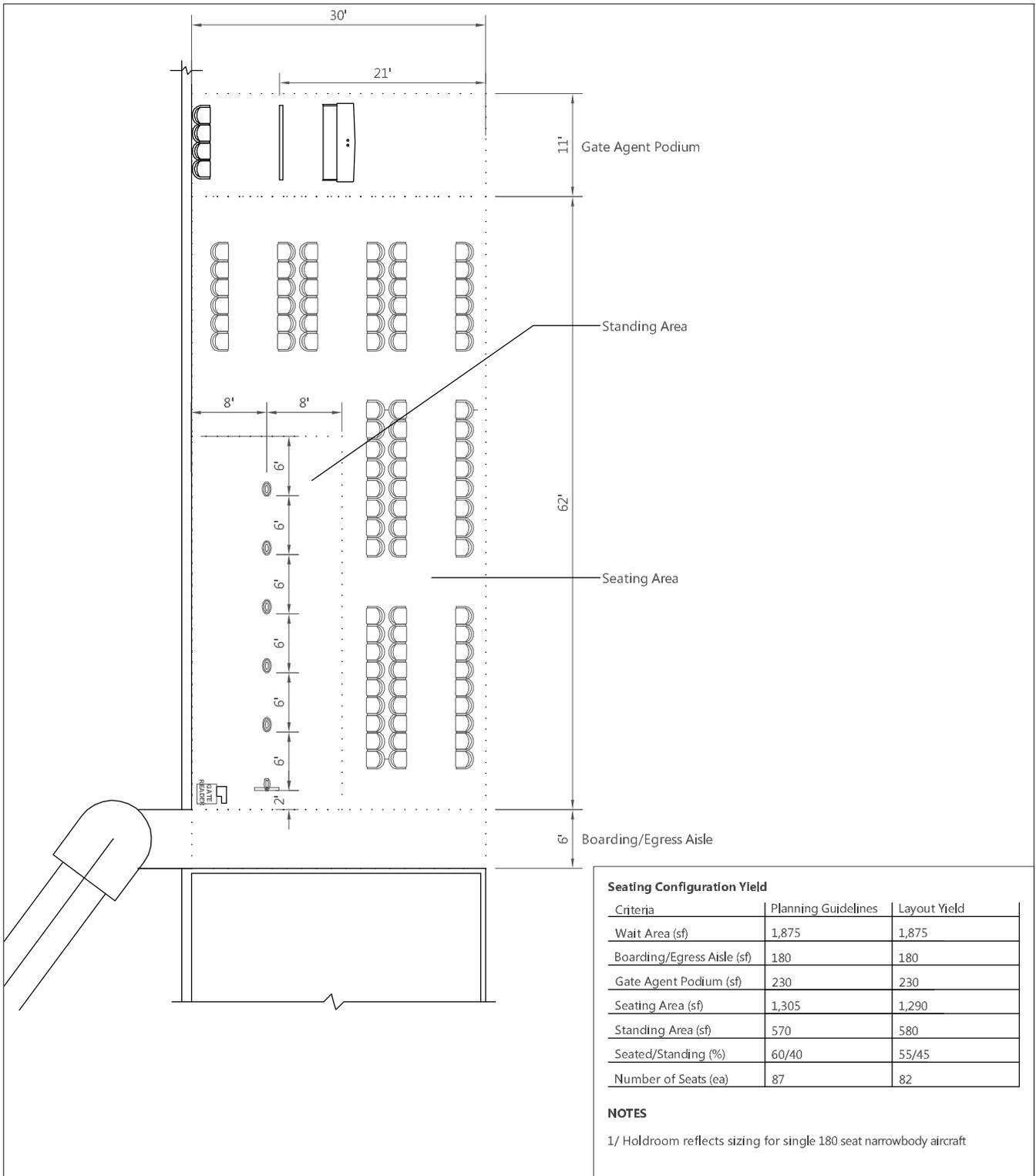
A traditional holdroom waiting area configuration provides challenges for airline and terminal operators, specifically during the boarding process when passengers queue in undefined boarding areas, resulting in passengers spilling into circulation aisles and obstructing the flow of other passengers to gates further down the concourse. Airlines and terminal operators are trying new holdroom layouts to improve gate access for passengers by providing dedicated boarding aisles (**Exhibit 2-18** and **Exhibit 2-19**). The integration of concessions into the holdroom areas has improved the departure lounge experience, while also increasing nonaeronautical revenue generation. **Exhibit 2-20** illustrates a concessions-integrated holdroom configuration.

Exhibit 2-18 illustrates a derivative holdroom seating configuration for expedited group boarding. Passengers are assigned a boarding letter and number, with assignments based on time of trip reservation on a first-come, first-served basis. During the boarding process, passengers remain seated until their boarding letter and number are called, at which point, passengers line up at the appropriately numbered post. As passengers remain seated until called, fewer passengers overflow into the central circulation corridor during the boarding process. This approach also helps clearly define the process for passengers, thereby limiting confusion. The derivative holdroom seating configuration divides the waiting area evenly between seating and standing areas; in the example shown on the exhibit, 82 seats can be accommodated (nearly complying with Port Authority guidelines), and the standing area also provides queuing space for boarding post signage.

Another derivative holdroom seating configuration is shown on Exhibit 2-19, which integrates the boarding/egress aisles with the standing area. In this configuration, queue stanchions indicate specific boarding lanes for passenger types (i.e., first class, business, economy, and priority boarding). This system reduces confusion and reduces the numbers of passengers spilling into the central circulation corridor during the boarding process. The configuration complies with Port Authority guidelines in terms of number of seats (106 seats), floor area for seating (1,290 square feet), and boarding/egress and standing areas (750 square feet).

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[Preliminary Draft for Discussion Purposes Only]



SOURCE: Port Authority of New York New Jersey Planning and Design for Terminals and Facilities, Airport Standards Manual, May 2005.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-18

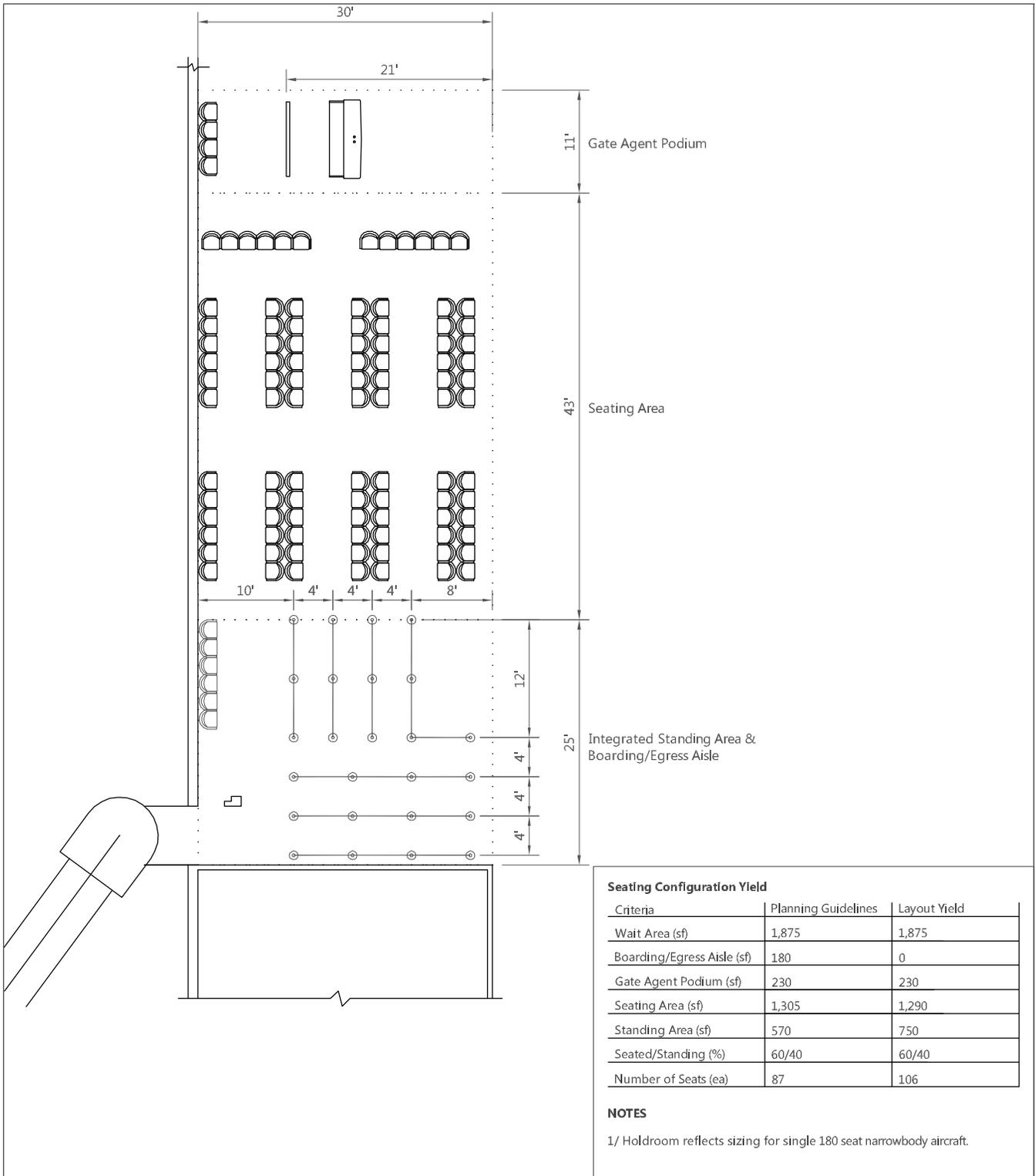


Narrowbody Holdroom Derivative Seating Configuration

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SOURCE: Port Authority of New York New Jersey Planning and Design for Terminals and Facilities, Airport Standards Manual, May 2005.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

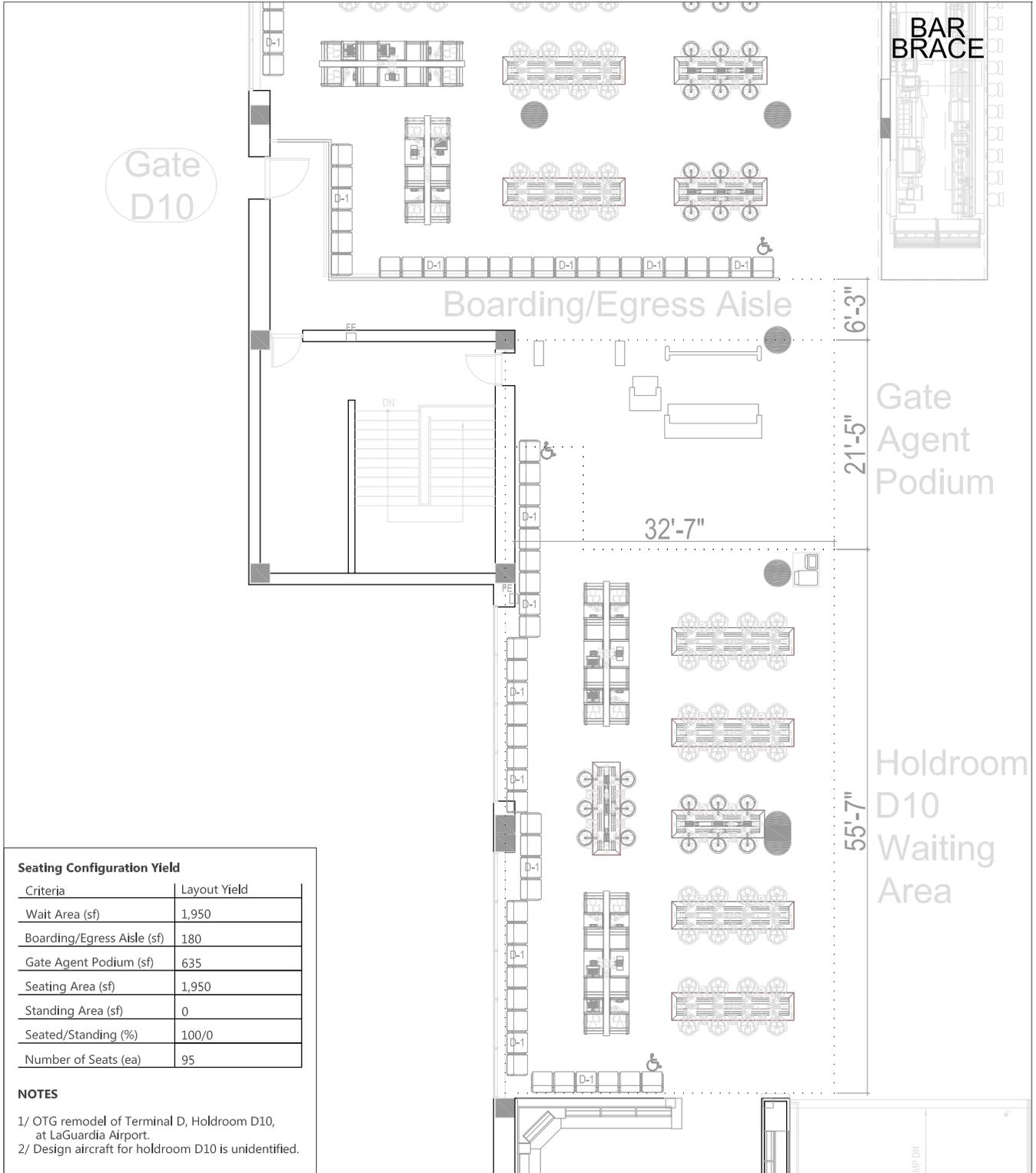
EXHIBIT 2-19



Narrowbody Holdroom Derivative Seating Configuration

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Seating Configuration Yield

Criteria	Layout Yield
Wait Area (sf)	1,950
Boarding/Egress Aisle (sf)	180
Gate Agent Podium (sf)	635
Seating Area (sf)	1,950
Standing Area (sf)	0
Seated/Standing (%)	100/0
Number of Seats (ea)	95

- NOTES**
- 1/ OTG remodel of Terminal D, Holdroom D10, at LaGuardia Airport.
 - 2/ Design aircraft for holdroom D10 is unidentified.

SOURCE: Port Authority of New York New Jersey, August 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-20



**Holdroom Layout
 Concessions Integration**

Drawing: N:\PANYNJ\Terminal Planning Guidebook\CAD\LGA Terminal D Departures_OTG Gate Layout.dwg_Layout/Layout1_Aug 12, 2013, 3:11pm

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Terminal concessionaires working with terminal operators are redefining the preboarding areas by merging concessions into the holdroom waiting areas. Exhibit 2-20 illustrates the holdroom layout for JetBlue Airways at Gate D10, Terminal D at LaGuardia Airport, where 100% of the waiting area incorporates concession programs. The seating area is furnished with food and beverage style group tables, workstations, individual seating, and, in some instances, a full-service food/drinks bar. This configuration, which blends concessions with the holdroom seating areas, provides revenue generation opportunities where passengers traditionally spend time sitting and waiting for aircraft boarding. Minimal standing area is available, and is mainly used as expanded boarding space. OTG Management's reconfigured holdroom offers a different experience for passengers, providing expanded customer service amenities and enjoyment.

2.5.4 RESTROOM PROGRAMMATIC INFORMATION

Restroom requirements include the quantity of lavatory fixtures needed to accommodate the expected numbers of occupants. Dimensional criteria based on area per fixture and circulation, and spatial guidelines for restroom layout are used to derive the restroom space program. Information used to develop restroom requirements include:

- Demand basis
 - Identification of governing building and plumbing codes
 - Type of Construction identification
- Level of service criteria
 - Fixtures per male/female ratio
- Dimensional criteria (space template)

Restroom – Level of Service and Spatial Planning Guidelines

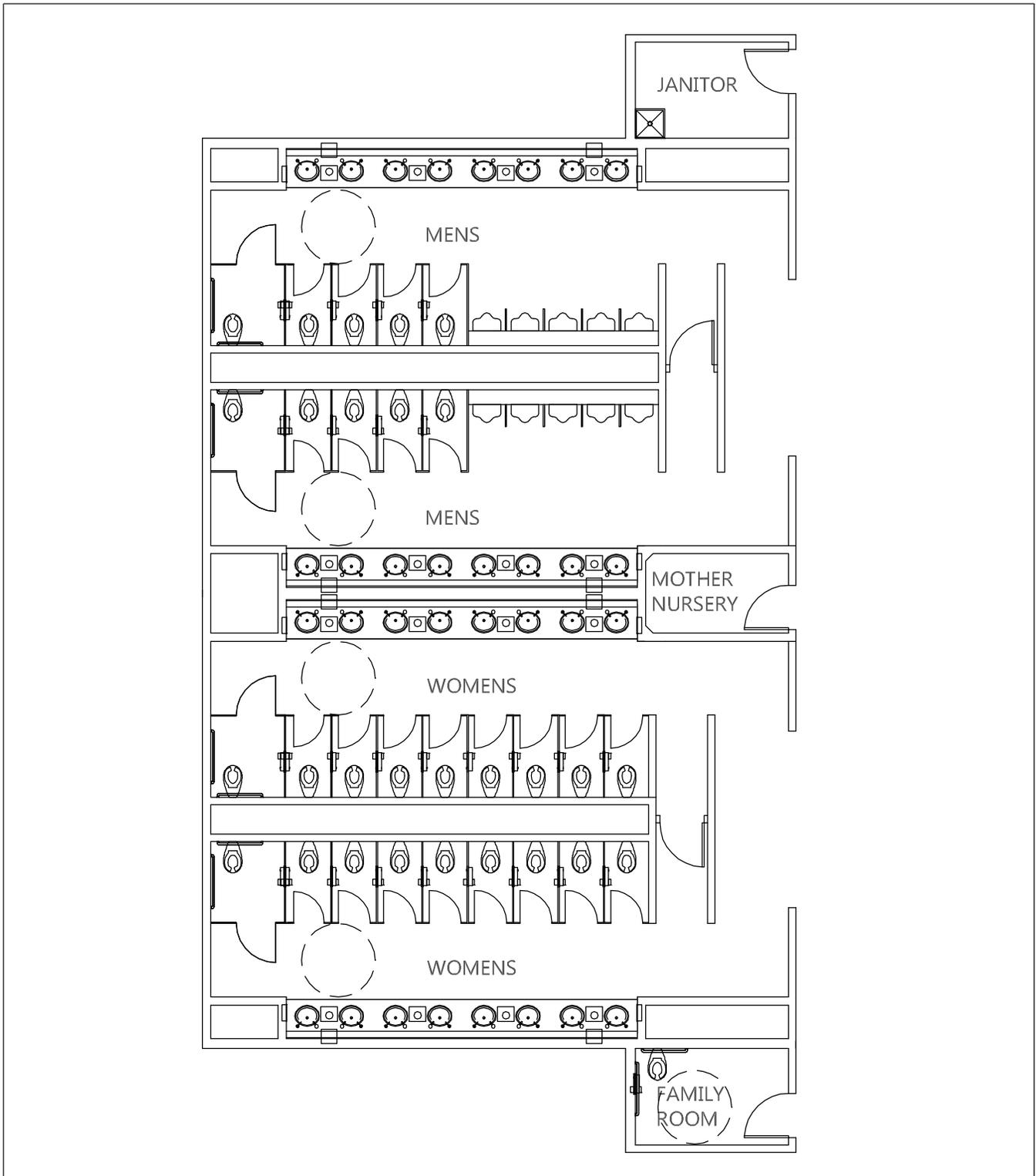
Level-of-service criteria for public restrooms are guided by the governing code that applies to each airport. Airport projects must comply with local building and plumbing codes and ADA guidelines during construction and renovations to provide adequate numbers of restrooms and lavatory fixtures.

Optimal restroom layout plans provide the capability to close off sections of the restroom with partitions for daily maintenance and renovations, while leaving other sections open for use. Restrooms in high activity areas, such as a concourse or terminal building, would always be open for passengers. A symmetrical restroom layout with dual access for maintenance and renovations, in accordance with the guidelines for restroom configurations, is illustrated on **Exhibit 2-21**.

The need for terminal operators to provide additional restroom amenities for passengers, such as mother nurseries, changing rooms, and family rooms, is a growing trend that is not addressed in local or national building codes. These amenities are needed for caregivers traveling with young children and babies; a private area to take care of the needs of toddlers out of sight of other passengers makes for a more pleasant environment. These amenities are crucial for travelers in need of such private areas, as such facilities may not have been provided at the originating airport or aboard the aircraft during a multiple-hour travel itinerary.

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[Preliminary Draft for Discussion Purposes Only]



SOURCE: Ricondo & Associates, Inc., August 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-21



Restroom Layout Restroom Configuration

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Restrooms – Dimensional Guidelines

Port Authority airports, LaGuardia and John F. Kennedy International Airports (LGA and JFK, respectively) in New York City are subject to the provisions of the New York City Plumbing Code. Stewart International Airport (SWF) in New Windsor, New York, and Newark Liberty International Airport (EWR) in Newark, New Jersey, are subject to the New York State Building and Plumbing Codes and the International Building Code New Jersey Edition, respectively. The codes provide a basis for construction type identification and fixture sizing.

Table 2-6 indicates the bases for calculating restroom occupancy, and **Table 2-7** indicates the code bases for determining the requirements for restroom fixtures at the Port Authority airports.

Table 2-6: Occupancy Calculation (in square feet per passenger)

	UNITS	NATIONAL FIRE PROTECTION ASSOCIATION CODE	NEW YORK CITY BUILDING CODE	NEW YORK STATE BUILDING CODE	INTERNATIONAL BUILDING CODE NEW JERSEY
Type of Construction	(classification)	Assembly	Airport Terminal	Passenger Terminal	Airport Terminal
Facility					
Terminal Lobby¹	(sf/pax)	15.0	-	-	-
Terminal Queue Area	(sf/pax)	7.0	-	-	-
Baggage Claim	(sf/pax))		20.0	20.0	20.0
Baggage Handling	(sf/pax)		300.0	30.0	300.0
Office	(sf/pax)	100.0	-	-	-
Concourse					
Circulation Corridor	(sf/pax)	100.0	100.0	100.0	100.0
Holdroom Waiting Area (Seated)	(sf/pax)	15.5	15.0	15.0	15.0
Holdroom Waiting Area (Standing)	(sf/pax)	15.5	5.0	-	5.0
Concessions (Food and Beverage)	(sf/pax)	15.0	-	-	-
Concessions (Retail)	(sf/pax)	30.0	-	-	-

Note:

1/ Consists of public circulation space on the non-secure side of airport terminals.

SOURCES: Building Code of New York City, 2008; International Building Code New Jersey Edition, 2009; National Fire Protection Association, NFPA 101 Life Safety Code, 2009; Building Code of New York State, 2010.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Table 2-7: Restroom Fixture Calculation

PLANNING CRITERIA RATIOS	UNITS	NEW YORK STATE PLUMBING CODE	NEW YORK CITY PLUMBING CODE	INTERNATIONAL BUILDING CODE NEW JERSEY ¹
Male : Female	(ratio)	50% : 50%	50% : 50%	50% : 50%
Fixture : Male	(ratio)	1 : 500	1 : 500	1 : 50
Fixture : Female	(ratio)	1 : 500	1 : 500	1 : 50
Sinks : Male	(ratio)	1 : 750	1 : 750	1 : 100
Sinks : Female	(ratio)	1 : 750	1 : 750	1 : 50
Service Sinks : Restroom	(ratio)	1 : 1	1 : 1	-
Maximum Distance between Restrooms	(feet)	300	300	-

Note:

1/ The New Jersey State Plumbing Code restroom fixture calculations are specific to airport passenger terminals.

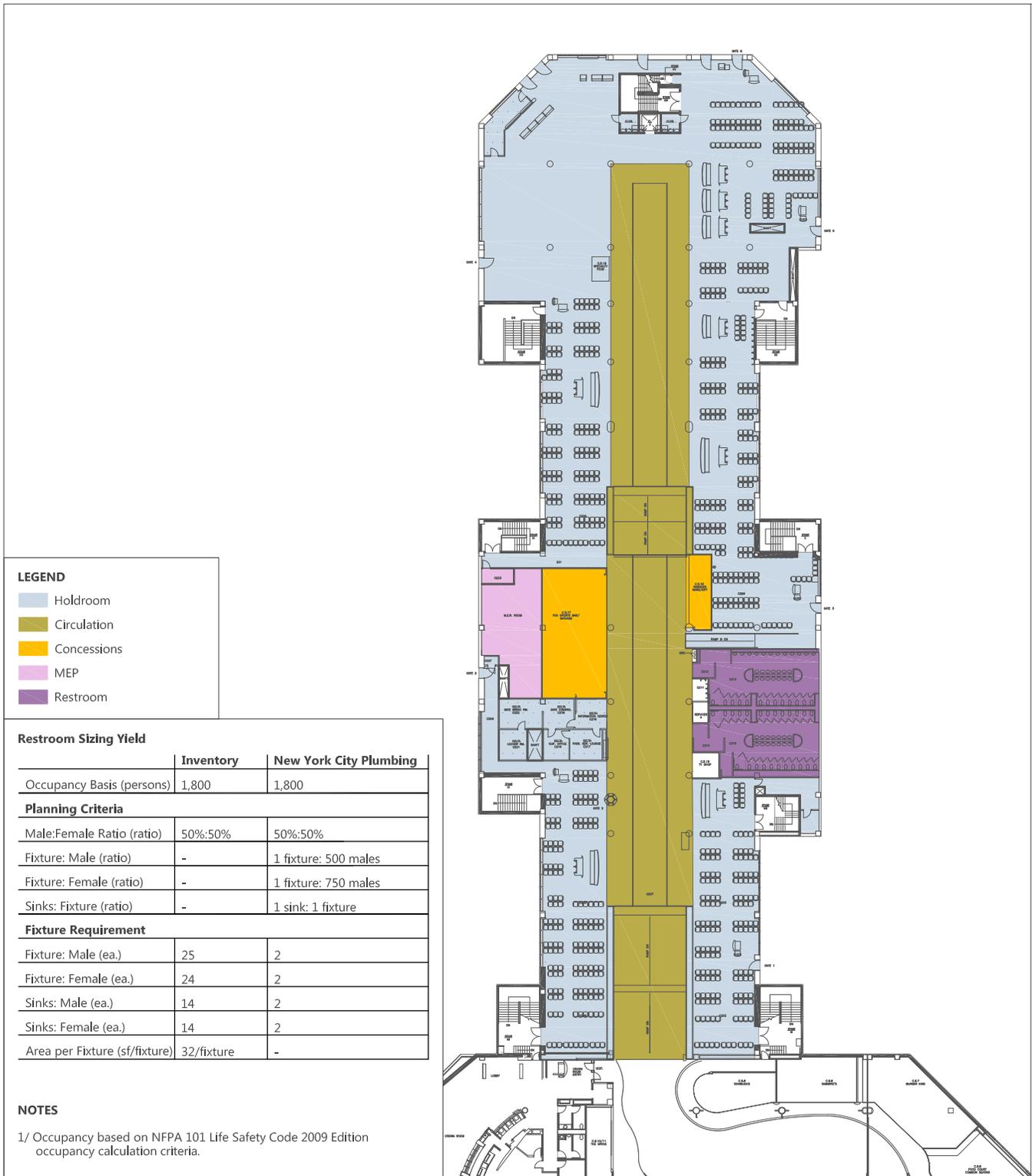
SOURCES: Building Code of New York City, 2008; International Building Code New Jersey Edition, 2009; National Fire Protection Association, NFPA 101 Life Safety Code, 2009; Plumbing Code of New York State, 2010.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Several Port Authority airport concourses were analyzed to evaluate restroom sizing for numbers of fixtures compared to the applicable governing code. **Exhibit 2-22** (LGA) and **Exhibits 2-23 and Exhibit 2-24** (JFK) illustrate floor areas used to calculate occupancy and presents the inventory of fixtures compared with code requirements. As shown on Exhibits 2-20 through 2-24, the evaluated airport concourses exceed the local governing codes regarding the provision of adequate fixtures for male and female restrooms. However, there aren't additional amenities in the restroom areas such as mother nurseries, family rooms, or changing rooms.

Exhibit 2-25 illustrates a concourse guide for distances between restroom locations. Design guidelines indicate that passengers should not have to travel more than 300 feet to the nearest restroom; meaning the recommended maximum distance between restrooms is 600 feet apart. Exhibit 2-25 presents a comparison of the restroom locations at JFK Terminal 4, Concourse B, which indicates that Concourse B complies with the distance guidelines and also provides adequate fixtures.

[Preliminary Draft for Discussion Purposes Only]



LEGEND

- Holdroom
- Circulation
- Concessions
- MEP
- Restroom

Restroom Sizing Yield

	Inventory	New York City Plumbing
Occupancy Basis (persons)	1,800	1,800
Planning Criteria		
Male:Female Ratio (ratio)	50%:50%	50%:50%
Fixture: Male (ratio)	-	1 fixture: 500 males
Fixture: Female (ratio)	-	1 fixture: 750 males
Sinks: Fixture (ratio)	-	1 sink: 1 fixture
Fixture Requirement		
Fixture: Male (ea.)	25	2
Fixture: Female (ea.)	24	2
Sinks: Male (ea.)	14	2
Sinks: Female (ea.)	14	2
Area per Fixture (sf/fixture)	32/fixture	-

NOTES

1/ Occupancy based on NFPA 101 Life Safety Code 2009 Edition occupancy calculation criteria.

SOURCE: Ricondo & Associates, Inc., August 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-22

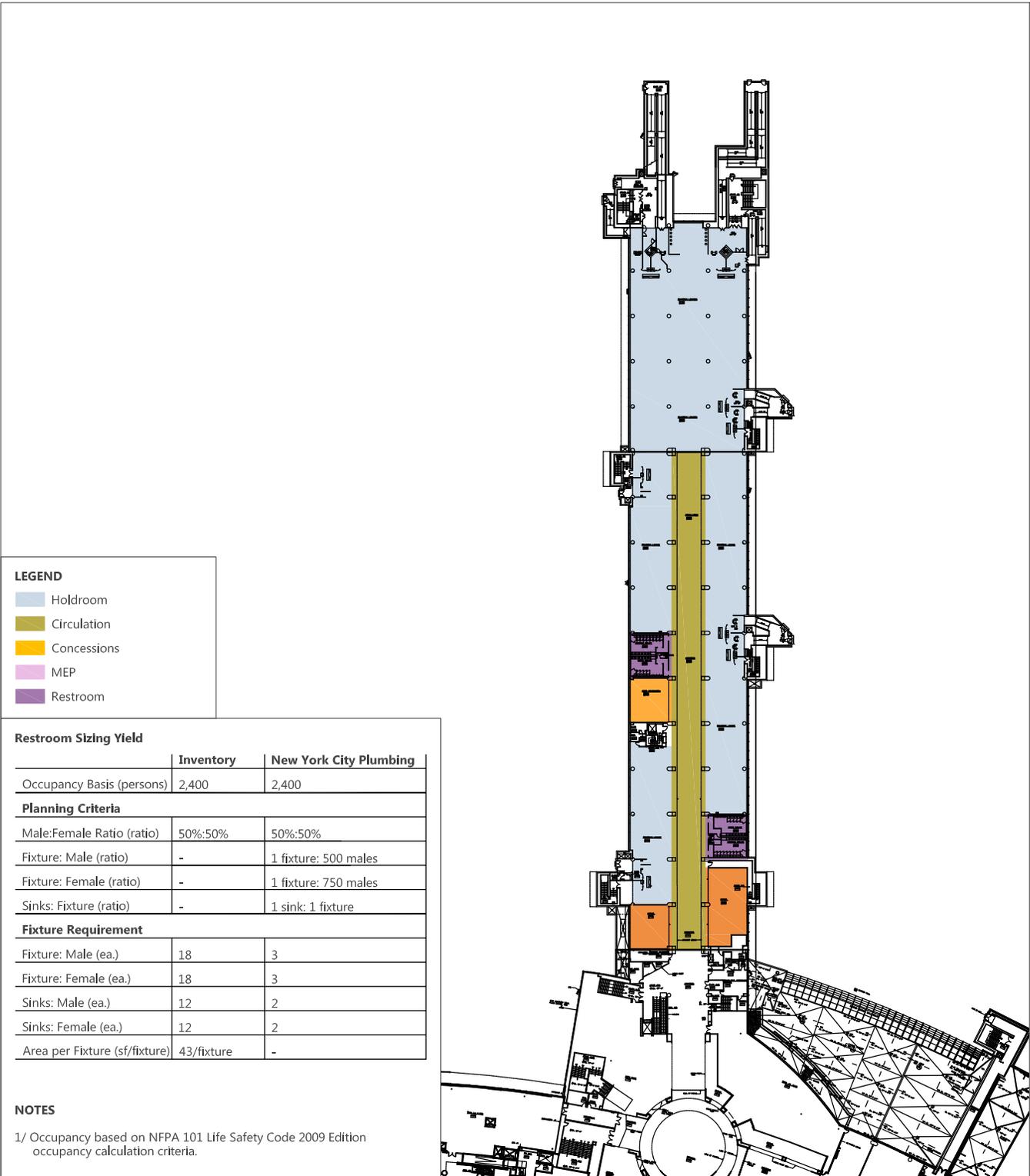


0 60 ft.

**Restroom Benchmark
LGA Terminal D**

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SOURCE: Ricondo & Associates, Inc., August 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-23

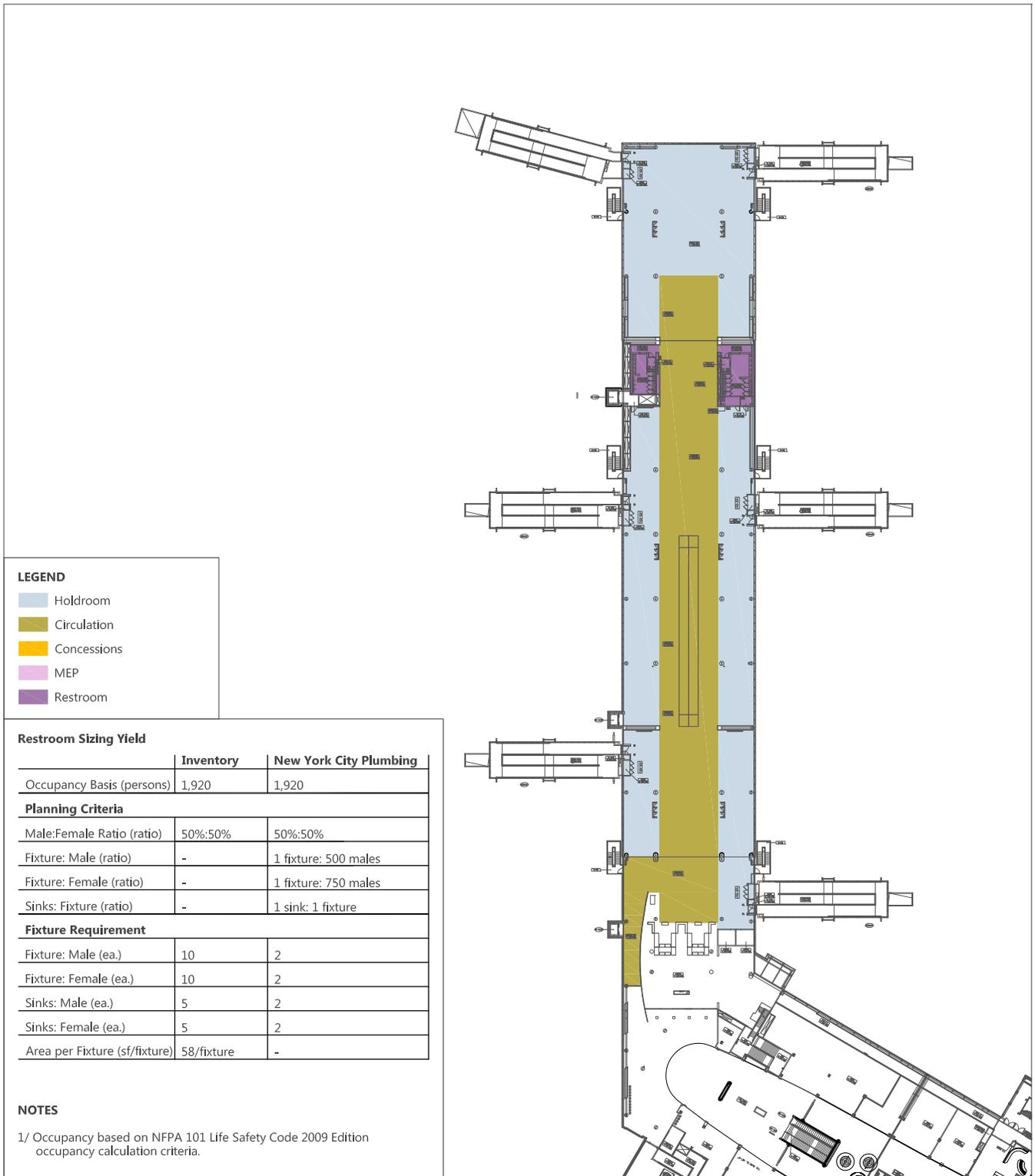


**Restroom Benchmark
 JFK Terminal 1**

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[Preliminary Draft for Discussion Purposes Only]



LEGEND

- Holdroom
- Circulation
- Concessions
- MEP
- Restroom

Restroom Sizing Yield

	Inventory	New York City Plumbing
Occupancy Basis (persons)	1,920	1,920
Planning Criteria		
Male:Female Ratio (ratio)	50%:50%	50%:50%
Fixture: Male (ratio)	-	1 fixture: 500 males
Fixture: Female (ratio)	-	1 fixture: 750 males
Sinks: Fixture (ratio)	-	1 sink: 1 fixture
Fixture Requirement		
Fixture: Male (ea.)	10	2
Fixture: Female (ea.)	10	2
Sinks: Male (ea.)	5	2
Sinks: Female (ea.)	5	2
Area per Fixture (sf/fixture)	58/fixture	-

NOTES

1/ Occupancy based on NFPA 101 Life Safety Code 2009 Edition occupancy calculation criteria.

SOURCE: Ricondo & Associates, Inc., August 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

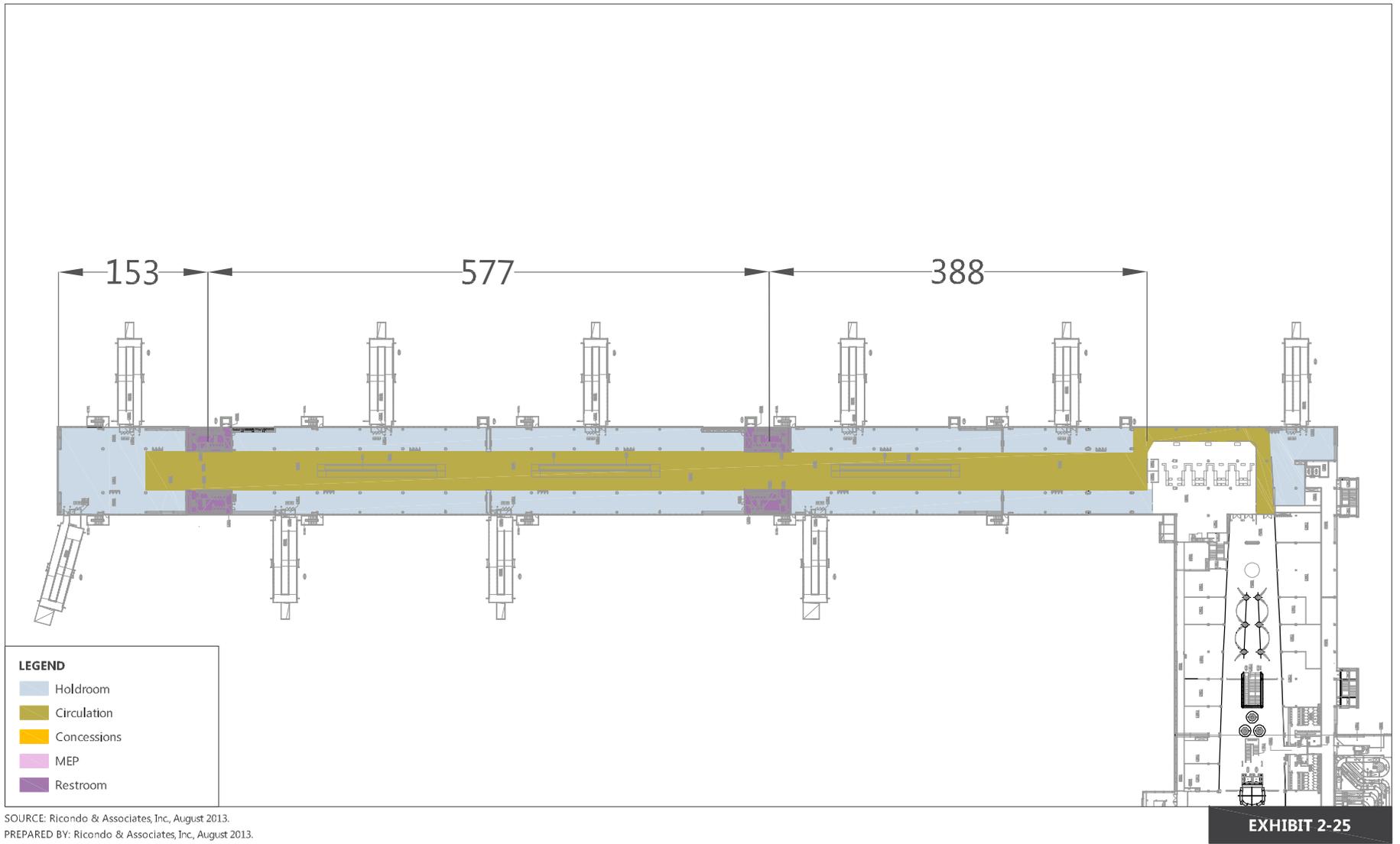
EXHIBIT 2-24



**Restroom Benchmark
 JFK Terminal 4 Concourse A**

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Restroom Location Benchmark
JFK Terminal 4 Concourse B



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2.6 Baggage Claim and Inbound Baggage Facilities

2.6.1 OVERVIEW

Upon flight arrival, airline personnel remove bags or unit load devices containing checked bags from the aircraft's cargo holds. These bags are carted to unload areas where they are manually transferred onto flat sections of conventional conveyors that transport bags to the domestic or international baggage claim areas. Unload areas for international bags are considered sterile areas under the jurisdiction of the CBP. Unload areas for inbound (arriving) domestic bags are usually co-located with outbound (departing) baggage makeup areas.

Baggage claim for domestic flights is located in nonsecure areas of airport terminals with direct access to the curbside and accessible to meeters/greeters. Baggage claim for international flights is located in the CBP Federal Inspection Services (FIS) facilities, downstream of document check (passport control), and is part of the sterile area.

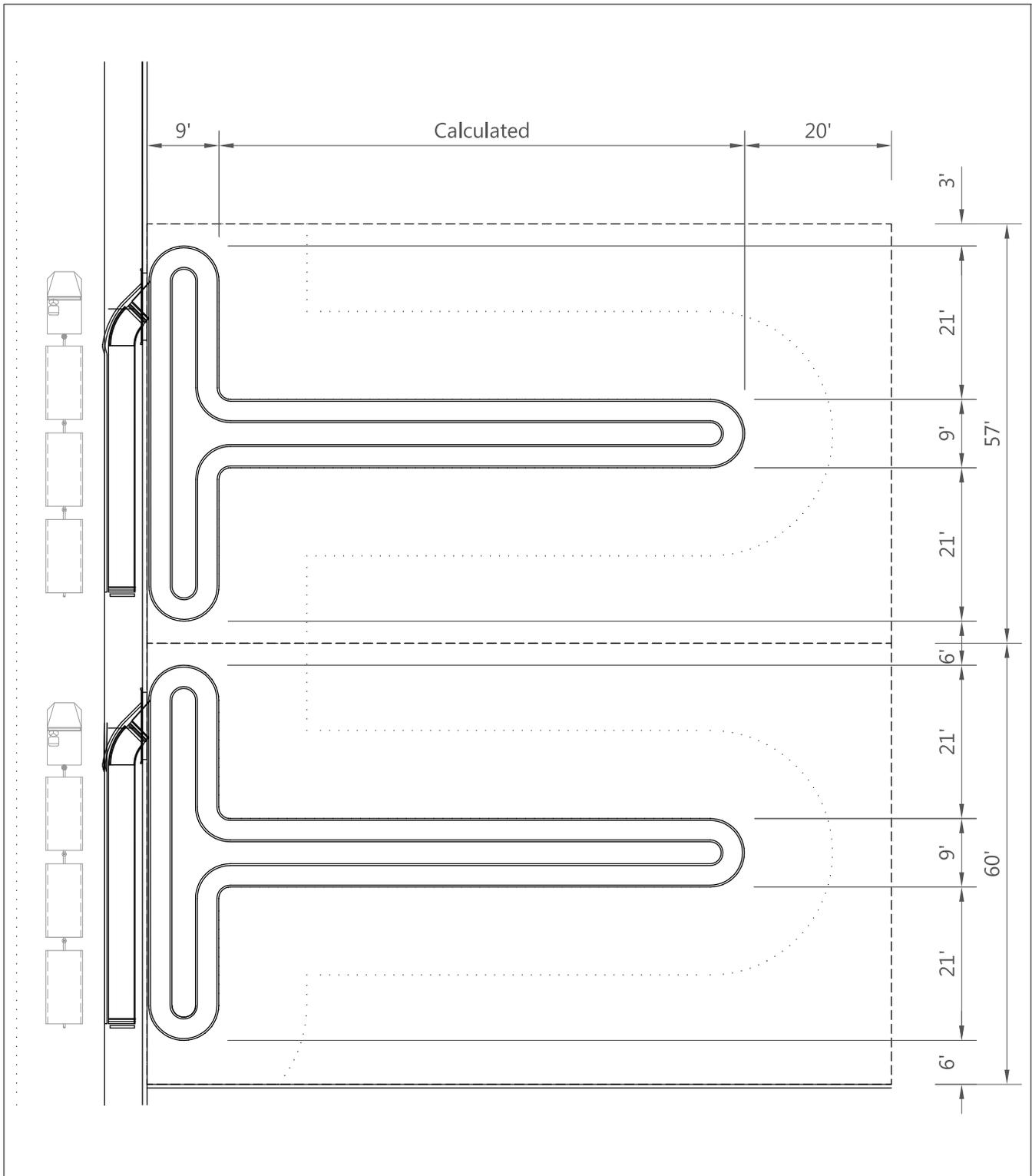
There are three types of baggage claim devices: sloped plate carousels, flat plate racetracks, and simple claim shelves:

- **Sloped plate carousels** are used when the inbound baggage unload area is on a different floor or otherwise remote from baggage claim. Carousels can be fed by conventional conveyors connecting from the ceiling or from the floor, and can hold more bags because the conveyor feeds allow presentation along the entire perimeter length of the device. Additional capacity is gained because bags can also stack along the slope. Carousels can be fed from two separate sets of unload conveyors, which allows two baggage train carts to be unloaded simultaneously.
- **Flat plate racetracks** are used when the inbound baggage unload area is on the same floor as baggage claim and is able to directly feed baggage claim, typically through the demising wall separating the Secure Identification Display Area (SIDA) from baggage claim. Flat plate racetracks can be configured in various shapes ("T," "U," or "L") to provide the necessary presentation length and, when active, the conveyor plates recirculate between the SIDA and the baggage claim space through wall openings equipped with fire/security shutters.
- **Simple claim shelves** can be used for low activity terminals and for delivery of oversized/odd-sized checked items. Shelf units are not mechanized; items are delivered through an opening in the SIDA demising wall, which is equipped with fire/security shutters.

Trends and Innovations

The TSA has expressed concern regarding the design of flat-plate, through-wall baggage claim units, which recirculate baggage between secure and non-secure spaces, inherently providing an opportunity to circumvent access control measures. Terminal operators have increased security operational measures and the use of closed-circuit television surveillance in response. A derivative design for a flat-plate, through-wall baggage claim unit that eliminates baggage recirculation is illustrated on **Exhibit 2-26**.

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SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-26



Bag Claim Benchmark Through Wall Device

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Increasingly, passengers prefer to use self-service kiosks that allow them to scan bar codes on their baggage claim tickets to quickly track delayed bags and circumvent waits for baggage service agents. Similar to self-service check-in, self-service kiosks used to track delayed bags provide a better experience for passengers and reduce workload for airline agents.

Baggage Image and Weight Identification Systems (BIWIS) have significant potential for streamlining international baggage claim protocols. BIWIS, which are already in use at newer CBP preclearance locations, allow CBP agents to view baggage details electronically and to make clearance decisions in the absence of physical baggage. The operators of various airports outside the United States are implementing BIWIS as a way to eliminate the need for international transfer passengers to claim and recheck their bags. Adoption within the United States would significantly reduce current CBP facility requirements and expedite the adoption of self-service and paperless foreign entry documentation.

The Port Authority's Airport Terminal of the Future workshop highlighted opportunities to further enrich the arriving passenger's experience of the terminal by considering improvements, such as providing:

- A refresh area for business travelers; necessities for returning residents and employees
- Seamless transition from aircraft to ground transportation with intuitive wayfinding and clear lines of sight

Supplemental References

- IATA ADRM, 2004:
 - Chapter F, Section 9.6, "Baggage Claim Unit"
 - Chapter F, Section 9.10.6, "Number of Baggage Claim Units"
- ACRP Report 25, Vol. 1. *Guidebook*, 2010:
 - Chapter VI, Section 3.7, "Domestic Baggage Claim"
 - Chapter VI, Section 3.12.2, "Baggage Off-Load Area"
 - Chapter VI, Section 4.1.4, "Inbound Baggage Systems"
- Port Authority of New York and New Jersey, *Airport Terminal of the Future Workshop - Notes and Highlights*, September 19, 2012

2.6.2 PROGRAMMATIC INFORMATION

Baggage claim requirements include the amount of space needed to accommodate the types, numbers, and sizes of baggage claim devices, and space required to support terminal activity. Performance criteria are applied against activity (demand) to determine the supply and sizes of unit claim devices. Dimensional criteria based on level of service criteria and operating requirements are then applied to the required quantity of unit claim devices and the number of passengers in waiting areas (active baggage claim areas) to derive the initial space program.

For purposes of detailed planning, separate analyses should be conducted for each airline operating in the terminal and differences in operating parameters and passenger characteristics among the airlines should be considered. Individual airline requirements would then be aggregated according to terminal facility use (exclusive, preferential, or shared) to formulate the overall program requirement for baggage claim facilities and space. Because of the nature of passenger and baggage flows from the aircraft, requirements are calculated differently for domestic and international baggage claim facilities. Both domestic and international baggage claim requirements should be based on the design aircraft for terminal operations. Domestic baggage claim requirements consist principally of the area needed to hold the number of passengers accumulated in the active claim area while waiting for their bags to be delivered to the baggage claim unit. However, in determining international baggage claim requirements, the number of bags that accumulate on a claim unit as a result of upstream processes to clear arriving international passengers through passport control must be considered. Critical information necessary for calculating baggage claim requirements for each airline or groups of airlines includes:

- Operating parameters
 - Rules for use: claim device availability, flight close-out time, use/lease basis
 - First bag delivery to claim after aircraft arrival
- Demand basis
 - Planning schedule analyses by airline
 - Design aircraft and seating configuration
 - Passenger accumulation period
 - Percentage of passengers checking bags, and checked bags per passenger checking bags
 - Domestic baggage claim: total number of passengers claiming bags per flight and amount of time bags from a flight occupy the claim unit
 - International baggage claim: largest number of bags accumulated on the claim unit from an arriving flight
- Level of service criteria
- Dimensional criteria (space template)

Properly determining baggage claim requirements is complex because many contributing factors need to be considered, including: selection of design aircraft, effects from upstream processes on passenger and baggage streams, and overlapping flight arrivals using a single baggage claim device. In most cases, spreadsheet models can be used to reasonably calculate domestic baggage claim requirements; however, the dynamic nature of matching international passengers to their checked bags requires computer modeling of the international arrivals process to most accurately determine international bag claim requirements. A sample calculation for a domestic baggage claim area is provided in **Table 2-8**, and a sample calculation for an international baggage claim area using “rule-of-thumb” factors is presented in **Table 2-9**.

Table 2-8: Sample Domestic Baggage Claim Area Sizing

PASSENGER BASIS	UNITS	
Number of Aircraft Seats	(seats)	175
Aircraft Load Factor	(%)	90
Number of Terminating Passengers	(pax)	158
Terminating Passengers Claiming Bags	(%)	100
Passengers at Baggage Claim	(%)	100
Total Number of Passengers at Baggage Claim	(pax)	158
LOS C Square Footage per Passenger	(sf/pax)	14
Total Active Claim Area	(sf)	1,895
Claim Device Length (linear presentation frontage)	(ft)	135

SOURCE: Ricondo & Associates, Inc., May 2013.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Table 2-9: Sample International Baggage Claim Area Sizing

BAGGAGE BASIS	UNITS	
Number of Aircraft Seats	(seats)	175
Aircraft Load Factor	(%)	90
Number of Deplaning Passengers	(pax)	158
Deplaning Passengers Claiming Bags	(%)	100
Number of Bags per Passenger	(factor)	1.5
Total Bags on Baggage Claim Device	(%)	50
Total Number of Bags on the Claim Device	(bags)	120
Linear Feet of Presentation Frontage per Bag	(ft)	1.5
Claim Device Length (linear presentation frontage)	(ft)	180

SOURCE: Ricondo & Associates, Inc., May 2013.

PREPARED BY: Ricondo & Associates, Inc., August 2013.

Baggage Claim – Level of Service and Spatial Planning Guidelines

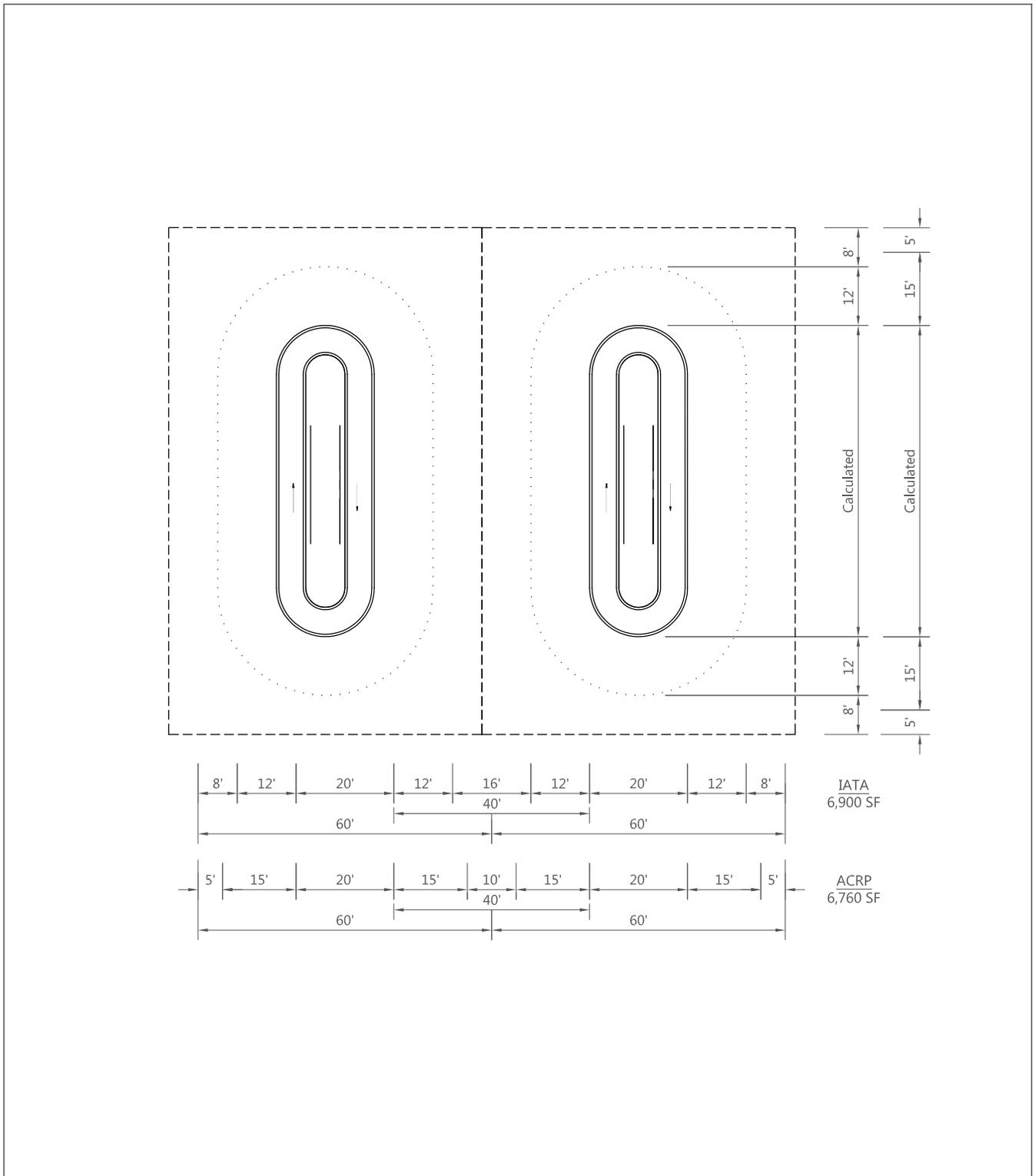
The dimensional guidelines for through-wall baggage claim devices and the associated inbound baggage claim facility are illustrated on Exhibit 2-26. The dimensional guidelines for carousel baggage claim devices and the associated inbound baggage claim facility are illustrated on **Exhibit 2-27** and **Exhibit 2-28**. The guidelines consist of:

- Baggage claim device
- Active baggage claim area
- Circulation aisle between baggage claim devices and the active claim area
- Main circulation corridor

Inbound Bag Make-up

- Bag unloading pier that includes conveyor and unloading area
- Tug cart parking area, and bypass lane

Exhibit 2-29 and **Exhibit 2-30** illustrate dimensional guidelines overlay on two examples of Port Authority inbound baggage and baggage claim facilities at John F. Kennedy International Airport and LaGuardia Airport, respectively.



SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

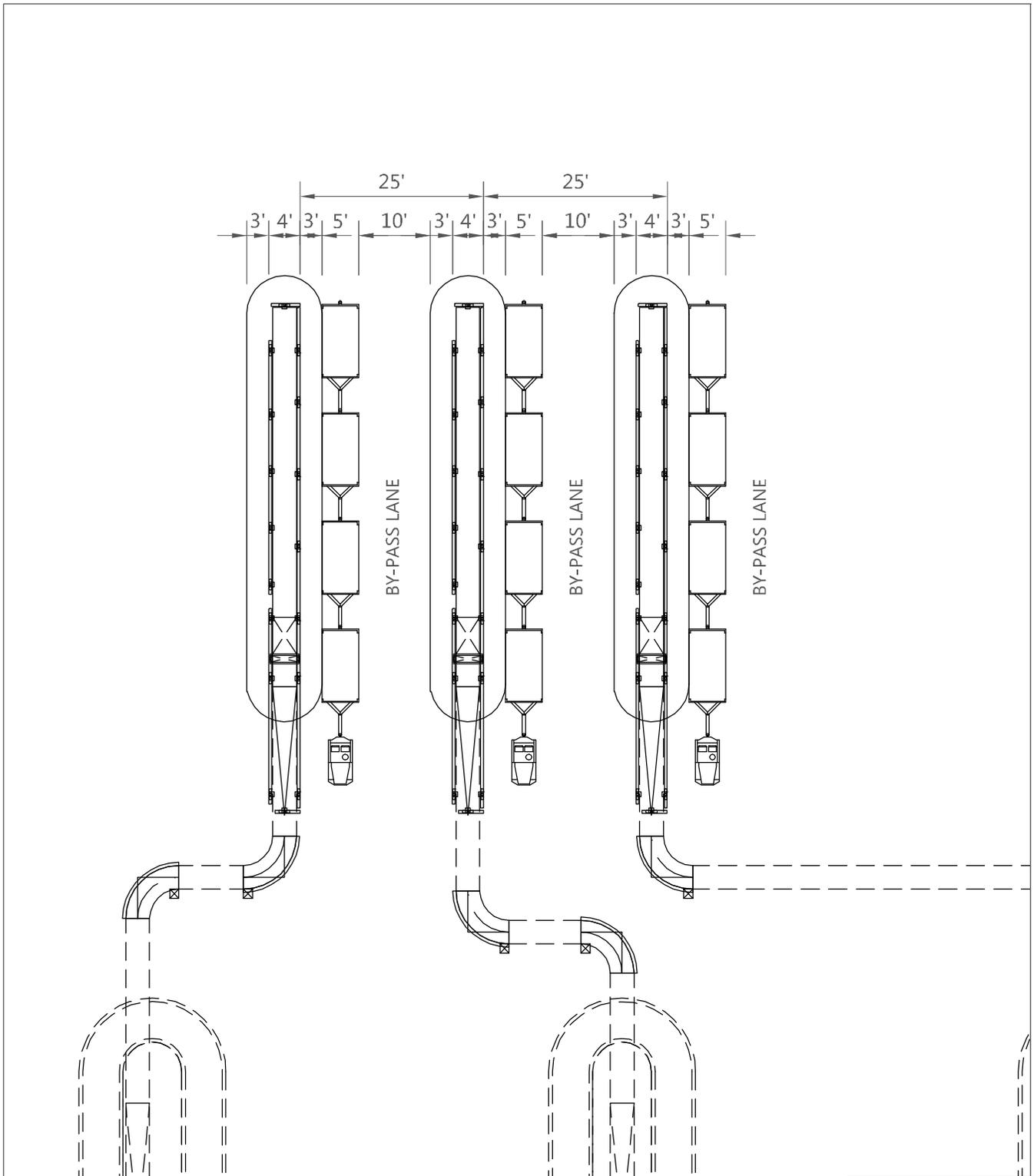
EXHIBIT 2-27



Bag Claim Benchmark Carousel Device

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SOURCE: Source IATA ADRM, ACRP Report 25, June 2013.
PREPARED BY: Ricondo & Associates, Inc, August 2013.

EXHIBIT 2-28

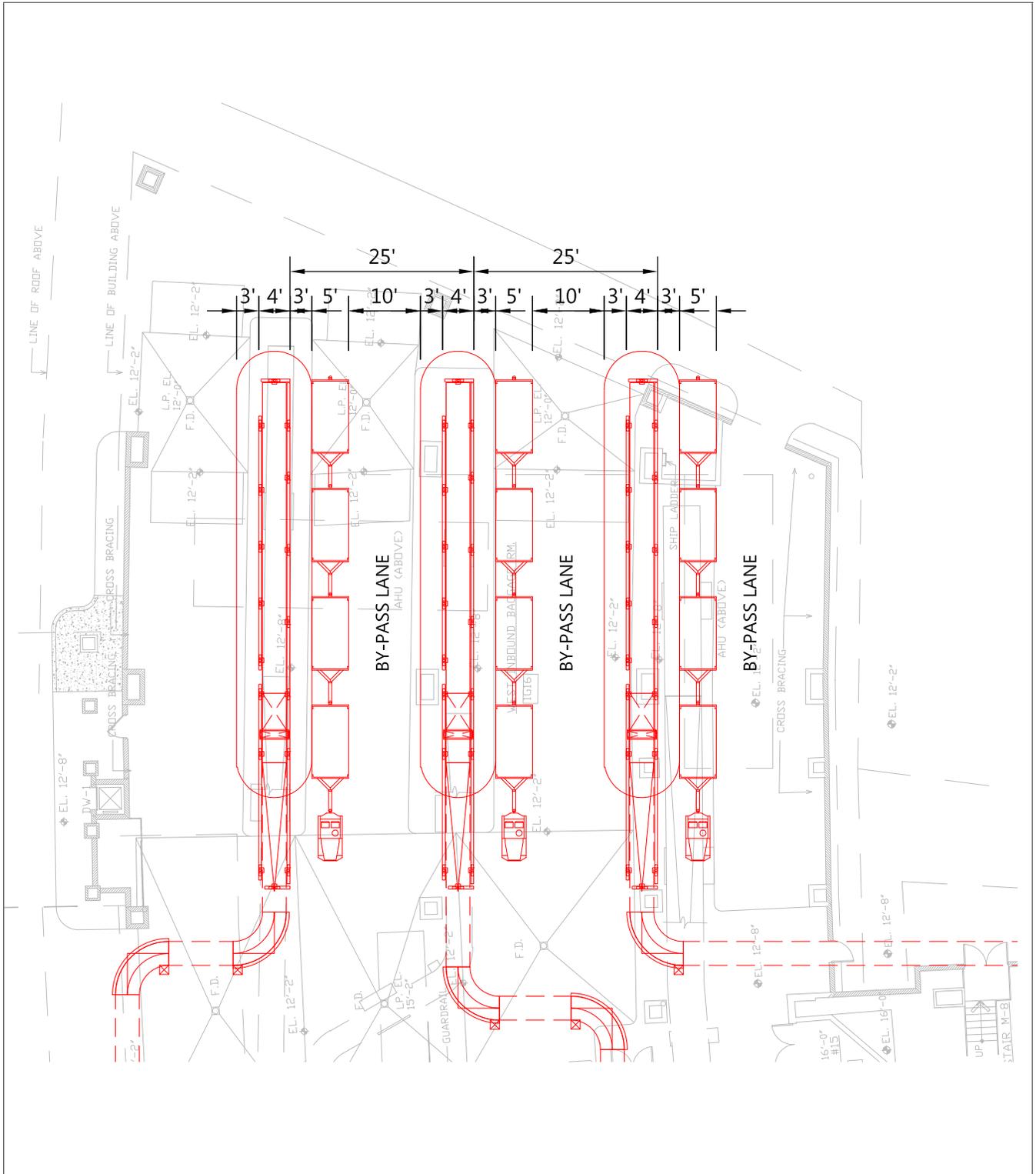


0 30 ft.

Inbound Pier Benchmark

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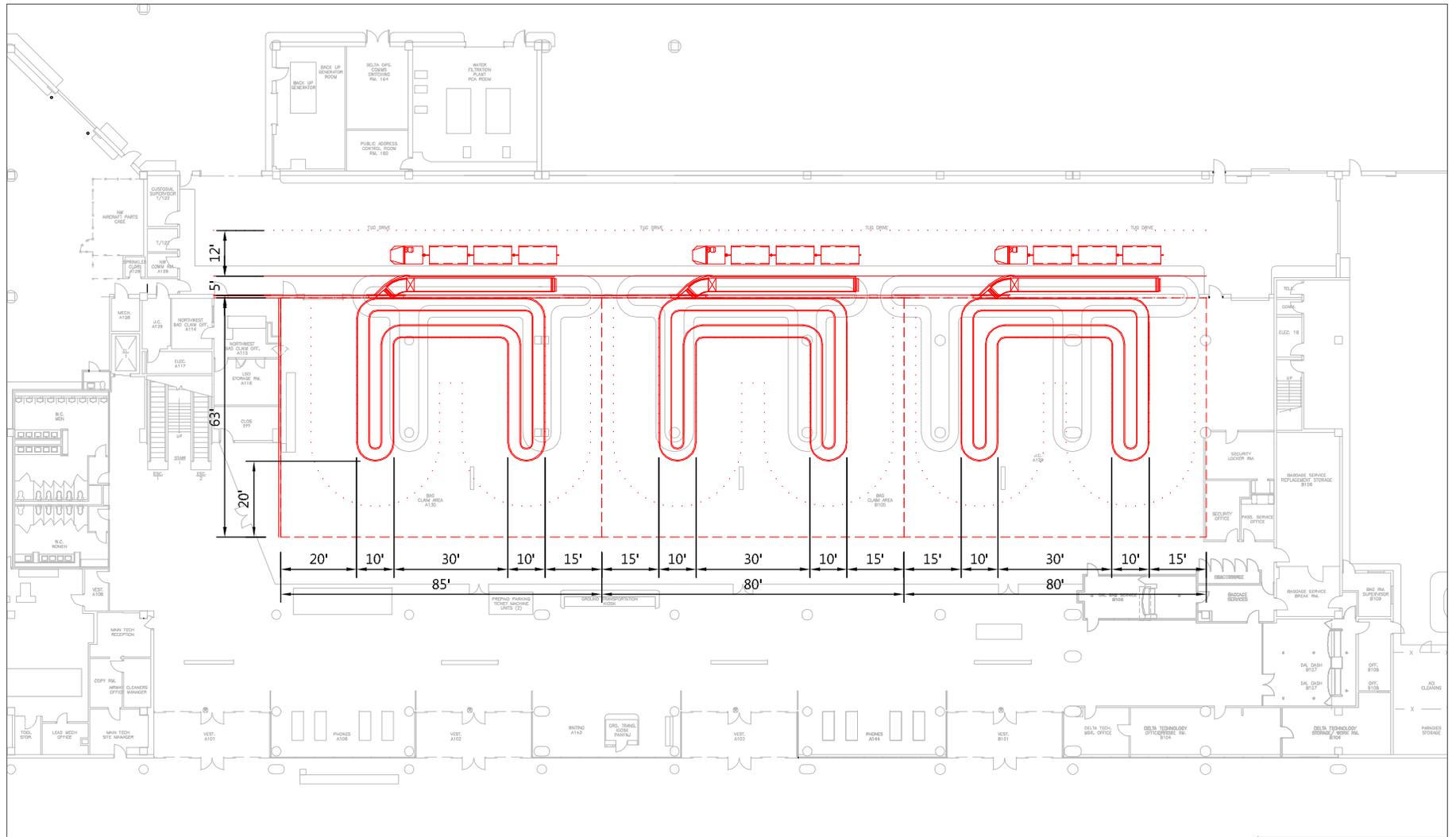
SOURCE: Ricondo & Associates, Inc., June 2013.
 PREPARED BY: Ricondo & Associates, Inc., August 2013.

EXHIBIT 2-29

Inbound Pier Overlay JFK Terminal 1

Drawing: N:\PANYNJ\Terminal Planning Guidebook\CAD\Terminal Comparisons\UJK Term-1 Arrivals LVL.dwg_Layout: Inbound Pier_Aug 13, 2013, 10:27am

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SOURCE: Ricondo & Associates, Inc, June 2013.
 PREPARED BY: Ricondo & Associates, Inc, August 2013.

EXHIBIT 2-30



**Bag Claim Overlay
 LGA Terminal D**

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2.7 U.S. Customs and Border Protection Port of Entry Facilities

Overview

Passengers arriving on international flights are required by the Department of Homeland Security (DHS) to be screened and cleared at the Customs and Border Protection (CBP) FIS facility for immigration processing prior to gaining entry into the United States. CBP screens passengers and their baggage to prevent the import of regulated goods, weapons, drugs, and other contraband, as well as to prevent suspicious passengers on threat lists from entering the United States. The traditional process at the FIS facility for passengers who are not U.S. citizens is presented below in sequential order:

- *Primary Inspection:* Passengers have passport identification checked, and declares checked baggage items.
- *International Baggage Claim:* After clearing primary inspection, passengers must claim their bags and proceed to exit control.
- *Exit Control:* Passengers submit their immigration form and are granted entry into the United States, or are directed with their checked baggage to secondary screening.
- *Secondary Screening:* Passengers who are selected for secondary screening are directed to Department of Agriculture or Customs screening of checked baggage, or secondary screening of passports and immigration forms.

Trends and Innovations

Decreases in funding for DHS programs has led to constrained staffing of CBP officers at FIS facilities nationwide, resulting in prolonged processing of passengers at primary inspection and, in some cases, the overloading of bags on baggage claim devices. New trends to mitigate constrained staffing are technology-based, and include the installation of automated kiosk systems providing expedited processing at primary inspection. The CBP Global Entry program is the current manifestation of an expedited screening program for passengers who frequently travel internationally. Stemming from the Global Entry program, unstaffed primary inspection booths are being replaced by kiosks for passengers to complete the primary inspection process. The implication for terminal planning is that expedited screening increases processing throughput at primary inspection and reduces the area required to hold passengers waiting for immigration.

Supplemental References

- CBP FIS facility planning and design guidelines are confidential documents, which require Service Set Identification clearance. Accesses to these documents are granted to airport architects and planners on a project-by-project basis pending clearance of identification and background checks by Department of Homeland Security.
- *ACRP Report 61, Elimination or Reduction of Baggage Recheck for Arriving International Passengers, 2012.*

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3. Annotated Bibliography

The literature search resulted in a collection of materials from various government agencies, academic sources, and aviation and airport organizations. The collected information was subsequently explored in *Part 2 – Terminal Planning Guidelines* with a goal of identifying current industry standards and trends for various terminal facilities.

An annotated bibliography resulting from the literature search and review is contained in **Section 3.1**.

3.1 Annotated Bibliography

1. Airport Cooperative Research Program, *ACRP Report 67, Airport Passenger Conveyance Systems Planning Guidebook*, 2012.

This resource manual provides a decision-support tool for planning, designing, and evaluating passenger conveyance systems at airports.

2. Airport Cooperative Research Program, *ACRP Report 40, Airport Curbside and Terminal Area Roadway*, 2010.

The guide describes the unique operating characteristics of airport terminal area roadways and curbside areas, and how their operations differ from those of urban streets and regional highways. The guide presents methods for estimating existing and future airport roadway requirements and alternative methods for analyzing operations on airport roadways.

3. Airport Cooperative Research Program, *ACRP Report 25, Airport Passenger Terminal Planning and Design, Volume 1: Guidebook*, 2010.

The guidebook is intended to supplement the guidebooks provided by the International Air Transport Association (IATA) and the Federal Aviation Administration (FAA) Advisory Circular documents with updated and new information for terminal planners, designers, and airport owners and operators.

4. Airport Cooperative Research Program, *ACRP Report 61, Elimination or Reduction of Baggage Recheck for Arriving International Passengers*, 2012.

This report identifies potential alternative procedures that could be implemented to reduce or eliminate the need for the recheck of baggage for arriving international passengers at U.S. airports; evaluates the

cost and benefits of for each alternative procedures to airports, airlines, and federal agencies; and compares the alternative procedures to current practices.

5. Airport Cooperative Research Program, *ACRP Report 10, Innovations for Airport Terminal Facilities*, 2008.
This report explores worldwide developments in airport landside facilities design, and examines future trends and innovative passenger service/processing concepts.
6. Airport Cooperative Research Program, *ACRP Report 35, Planning for Offsite Airport Terminals*, 2010.
This report provides a planning guide to airport staff and other decision makers when planning and developing remote terminal facilities; and examines how to identify potential customers for an offsite terminal and how the concept fits into airport planning.
7. Airport Cooperative Research Program, *ACRP Report 30, Reference Guide on Understanding Common Use at Airports*, 2010.
This report provides a reference guide and tools that can assist airports and airlines exploring the possibility of an evaluating the appropriateness of integrating "common use" in their operations.
8. Airport Cooperative Research Program, *ACRP Report 54, Resource Manual for Airport In-Terminal Concessions*, 2011.
This resource manual provides airport concession managers and other stakeholders, i.e. airport senior management, board members, concessionaires, and airlines, with an easy-to-use reference for understanding, planning and evaluating, managing, and developing airport in-terminal concessions.
9. Airport Cooperative Research Program, *ACRP Report 41, Guide to the Decision-Making Tool for Evaluating Passenger Self-Tagging*, 2010.
This report provides the information and tools necessary for an airport or airline to determine the appropriateness of pursuing passenger self-tagging.
10. Federal Aviation Administration, *Advisory Circular 150-5360-13*, 2011.
This resource manual provides airport concession managers and other stakeholders, i.e. airport senior management, board members, concessionaires, and airlines, with an easy-to-use reference for understanding, planning and evaluating, managing, and developing airport in-terminal concessions.
11. International Air Transport Association, *Airport Development Reference Manual (ADRM), 9th Edition, January 2004*.
This manual provides a reference tool for airlines, airports, architects and engineers, and consultants involved in airport development. The manual's content reflects recommendations of IATA experts in all areas of airport planning, development, and financing and operation.

12. International Air Transport Association, Copart, Stephan, *Fast Travel Program, Revision 5 – Final Document, May 10, 2012.*

This document provides an update to the Fast Travel Program document from 2009. The document outlines the strategy for implementation of the Fast Travel Program to achieve the program's vision of standardizing self-service check-in, bags ready-to-go, document check, flight rebooking, self-boarding, and bag recovery.

13. International Building Code, *New Jersey Edition, 2009.*

This document is the governing codebook of New Jersey State for new building construction and existing building renovation. The codebook defines types of construction, and use and occupancy classification and provides minimum requirements and standards for the regulation of construction in New Jersey State.

14. Los Angeles World Airports, *LAWA Public Restroom Design Guidelines and Specifications, July 7, 2008.*

This document establishes a minimum plumbing design guideline for LAWA for new building construction and existing building renovation. The guidelines incorporate State of California Building and Plumbing codes to establish recommendations of restroom design specific to airport terminals and concourses.

15. National Fire Protection Association, *NFPA 101 Life Safety Code, 2009 Edition.*

This is the national governing codebook that establishes design requirements and standards for new building construction and existing building renovations.

16. New York City Department of Buildings, Code Counsel, *Building Code of New York City, 2008.*

This document is the governing codebook of New York City for new building construction and existing building renovation. The codebook defines types of construction, and use and occupancy classification and provides minimum requirements and standards for the regulation of construction in New York City.

17. New York City Department of Buildings, Code Counsel, *New York City Plumbing Code, 2008.*

This document is the governing plumbing codebook of New York City for new building construction and existing building renovation. The codebook provides minimum requirements and standards that are applicable to the erection, installation, and alteration, repairs, relocation, and replacement, addition to, use or maintenance of plumbing systems in New York City.

18. New York State Department of State, Division of Code Enforcement and Administration, *Building Code of New York State, 2010.*

This document is the governing codebook of New York State for new building construction and existing building renovation. The codebook defines types of construction, and use and occupancy classification and provides minimum requirements and standards for the regulation of construction in New York State.

19. New York State Department of State, Division of Code Enforcement and Administration, *Plumbing Code of New York State, 2007.*

19. New York State Department of State, Division of Code Enforcement and Administration, *Plumbing Code of New York State*, 2007.

This document is the governing plumbing codebook of New York State for new building construction and existing building renovation. The codebook provides minimum requirements and standards that are applicable to the erection, installation, and alteration, repairs, relocation, and replacement, addition to, use or maintenance of plumbing systems in New York State.

20. OTG Management, *The NY Experience*, Presentation Received April 18, 2013.

This presentation by OTG Management provides an overview of OTG's holdroom and concessions vision. The presentation demonstrates examples of completed interior holdroom renovation projects that integrate concessions services and furniture layout into holdroom seating areas.

21. Plumbing-Heating-Cooling Contractors Association, *National Standard Plumbing Code Illustrated*, 2006.

This document is the governing plumbing codebook of New Jersey State for new building construction and existing building renovation. The codebook provides minimum requirements and standards that are applicable to the erection, installation, and alteration, repairs, relocation, and replacement, addition to, use or maintenance of plumbing systems in New Jersey State.

22. Transportation Security Administration, *Recommended Security Guidelines for Airport Planning, Design and Construction*, May 2011.

This document provides a guideline for planning, and design and construction of passenger security checkpoints facilities at airports.

23. Transportation Security Administration, Burns, Bob, *Future Attribute Screening Technology Mobile Module*, May 24, 2007.

This presentation provides an overview of the Transportation Security Administration's program for an innovative passenger screening technology. The program identifies prototype solution concepts for field testing using mobile research and development tools.

24. U.S Department of Homeland Security, U.S. Customs and Border Protection, *Airport Technical Design Standard*, June 2012.

This document is a secure document that contains sensitive security information; access to the document requires DHS approval and clearance of identity and background check. The document provides planning and design guidelines for international arrivals facilities.

