

Airport Planning Standards

Aviation Department - Port Authority of New York and New Jersey



PRELIMINARY DRAFT
Aviation Planning Division
Version 3

September 2018

Disclaimer

This draft is a working document of the Aviation Planning Division. The contents herein are currently under review by the Port Authority and are subject to change.

The Airport Planning Standards presented in this manual do not supersede any applicable codes or regulations. As codes are often updated, it is incumbent upon the designers to be aware of the current applicable codes for their project. Designers are required to comply with the requirements of the latest applicable building codes adopted by the State of New York and New Jersey, City of New York and Port Authority Engineering Department for the related buildings.

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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. Although there are several operating arrangements at PANYNJ airports, all terminal operator alteration proposals are subject to Port Authority approval under the Tenant Construction and Alteration Process (TCAP) - and permitting process.

The TCAP 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 airport operations. The Airport Standards Manual from 2005 was updated and retitled to "Terminal Planning Guidelines" in August 2013. This document "Airport Planning Standards" supersedes the previous terminal planning guidelines as a definitive Port Authority planning guide for airport planning. This manual takes into consideration latest industry planning guidelines, standards and trends, including but not limited to:

- Latest FAA Advisory Circulars: evolution in aircraft sizes and capabilities influences the standards for airfield design
- Latest industry standards and guidelines for airport planning.
- 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.
- Increasing emphasis of airports for enhanced passenger experience

Although the Port Authority's purview over such changes is dynamic for each airport, this document discusses how such changes should be considered when applying consistent planning principles. While the previous version of the standards included guidelines only on the terminal section, this document expands its scope to include standards for all planning elements: from developing a forecast to planning landside, terminal, and airside. The purpose of this document is to establish a general set of planning standards and performance criteria to evaluate development proposals from potential proponents. The document aims to serve as a reference document to various users such as planners, designers, analysts, and architects. The guidelines included in this document shall be representative of the Authority's Aviation Department' objectives in achieving the world-class level of customer satisfactions, and operational safety. The document guidelines and standards aim to:

- Incorporate changes to important spatial and design criteria and requirements brought about by emerging industry trends

- Enhance user understanding of issues that should be considered in developing or evaluating the facility requirements
- Expand the standards to address important airport facilities that were not discussed in the previous guidelines

This document is compiled based on information acquired through reviews of current federal and industry literature providing airport planning guidelines; reviews of completed contemporary airport facilities outside of and within the Port Authority’s jurisdiction; and the knowledge, expertise, and opinions of Port Authority staff. Any deviations from the standards and guidelines published in this document is subject to the Port Authority’s purview for approval.

Use and Organization of the Document

These Port Authority Airport Planning Standards are intended as a source of guidance for planning and designing airport facilities. The document includes the following elements which convey the Port Authority’s expectations for planning and development of any new facility at the airport:

Forecast: This section provides methodology and expectations from a forecasting effort: which should be undertaken for any planning exercise. The section describes the methodology for developing a design day flight schedule, collecting airport specific survey data, and identifies the deliverable expectation.

Airside: This section identifies guidelines on assessing facility requirements for various airside elements such as gates, hardstand and deicing positions. It includes essential site planning criteria which should serve as the minimum framework for any new planning and design study. The section also identifies airside concept of operations and conceptual design criteria to guide planners and designers with minimum requirements in an airside design.

Terminal: The section describes the various elements of a terminal building, guidelines for programming of facility requirements and space criteria for designing a terminal. The latest version for IATA ADRM as of the writing of this document, describes an “optimum” level of service for planning terminal facilities.

Landside: The section provides a comprehensive view of various landside elements to be considered for an efficient landside design at an airport. It identifies guidelines and standards for analysis of landside traffic as it pertains in the context of airport planning. To assist users with designing landside elements, the section presents detailed conceptual design criteria that serve as the Port Authority’s minimum expectations of a landside design.

The document identifies supplemental references and provides external publications that describe, in more detail, acceptable methodologies for calculating demand, capacity and 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.

SECTION I: FORECAST AND FUTURE DEMAND

1. Future Annual Demand – Directional Forecast

Future forecast annual demand must, at a minimum, be provided for three project milestone years (year of commencement of operations, +5-year, +20-year), and must include the following information:

- a. Annual aircraft operations and fleet mix for:
 1. Passenger airlines (domestic, international, total)
 2. Cargo airlines (where applicable)
 3. General Aviation (where applicable)
- b. Annual passenger volumes (domestic, international, total)
- c. Compound Annual Growth Rates (CAGR) for aircraft operations and passenger volumes
- d. Annual average Load Factor (domestic, international, total)
- e. Annual average “Origin & Destination / Transfer” Rates (domestic, international, total)

For comparison purposes, all data and figures provided for the three project milestone years must also be provided for existing conditions (baseline).

- f. Accepted Format(s):
 - Demand forecast data: Microsoft Excel format
 - Reports: Microsoft Word / PowerPoint / Adobe PDF format

This future demand information must be submitted to the Port Authority for review in order to ensure its conformity to the Port Authority’s in-house forecasts and the FAA Terminal Area Forecasts (TAF). Annual growth shall not be less than the greater of the Port Authority annual forecast or any forecast used by the proponent in the development of financial projections associated with the project.

At the discretion of the Port Authority supplementary incremental demand levels for additional milestone years (inside or beyond the 20-year planning horizon) , may be required.

2. Design Day Flight Schedule (DDFS)

Planning, concept validation, and design studies should be based on project-specific Design Day Flight Schedules (DDFS) that reflect the air service characteristics for the project. At a minimum, a detailed DDFS must be provided for the three project milestone years (year of commencement of operations, +5-year, +20-year).

While some calculations may be made on annual, daily or peak hour volumes, project-specific DDFSs are needed as some facilities may experience different peak periods. Planning Day schedules will also be necessary for simulation modelling where required.

For each project milestone year, the three following DDFS packages must be submitted to the Port Authority for review and approval:

- **DDFS Package 1: Flight Schedule Methodology and Daily Volumes Summary**
- **DDFS Package 2: Original Schedule files**

- **DDFS Package 3: Gate and Hardstand Chart (“Gantt Chart”)**

The information to be included in each DDFS package as well as the format(s) accepted are described below:

- a. **DDFS Package 1: Flight Schedule Methodology and Daily Volumes Summary**

- 1. PART 1: DDFS Methodology and Key Assumptions

The methodology for the selection of the baseline Design Day must be submitted to the Port Authority for review and approval. The proposed approach must be consistent with common FAA methodologies used to identify existing and forecast future peak activity. The typical selection methods used on PANYNJ projects are:

- Average Day of the Peak Month (ADPM)
- Average Weekday of the Peak Month (AWDPM)

For future flight schedules (year of commencement of operations, +5-year, +20-year), the “annualization” method used to derive Design Day passenger and aircraft operations volumes from the Annual Demand Levels must be submitted to the Port Authority for review and approval. The proponent should document assumptions, parameters and supporting methodology used for converting baseline ratios (design day: Annual demand ratio) to milestone year ratios, as applicable. Rationale for expecting changes in factors, including but not limited to, load factors, transfer percentage, peaking characteristics, seasonalities, markets, airline strategies, and slot assumptions should be documented and explained where applicable. This section must include, at a minimum, the Annual to Design Day Ratio selected for total passenger volumes and aircraft operations.

- 2. PART 2: DDFS Daily Volumes Summary

- i. Passenger volumes and operations per airline and aircraft type for the Design Day (domestic/international/total)
 - ii. 24-hour daily profiles (rolling hour) of aircraft operations and passengers (Graph – see sample Figure 1)
 - iii. Peak Hour volumes for the morning (3:00 AM-11:59 AM) and the afternoon (12:00 PM-2:59 AM), for the following categories:
 - Aircraft operations:
 - Arrivals (domestic/international/total)
 - Departures (domestic/international/total)
 - Total operations (domestic/international/total)
 - All passengers:
 - Enplanements (domestic/international/total)
 - Deplanements (domestic/international/total)
 - Total passengers (domestic/international/total)
 - O&D passengers:
 - Enplanements (domestic/international/total)
 - Deplanements (domestic/international/total)

- Total passengers (domestic/international/total)
- Transfer passengers:
 - Total passengers (domestic/international/total)

Load Factors of domestic, international and regional activity must be provided for multiple hours during the Design Day. At a minimum, load factors for the Peak Hour morning and afternoon, as defined in the previous section, must be included in the summary document.

O&D/Transfer rates of domestic, international and regional activity must be provided for multiple hours during the Design Day. At a minimum, the O&D/Transfer rates for the Peak Hour morning and afternoon, as defined in the previous section, must be included in the summary document.

Based on the project scope, the Port Authority may require additional details and information on the existing and future activity levels (e.g., cargo traffic, tonnage and peak operations).

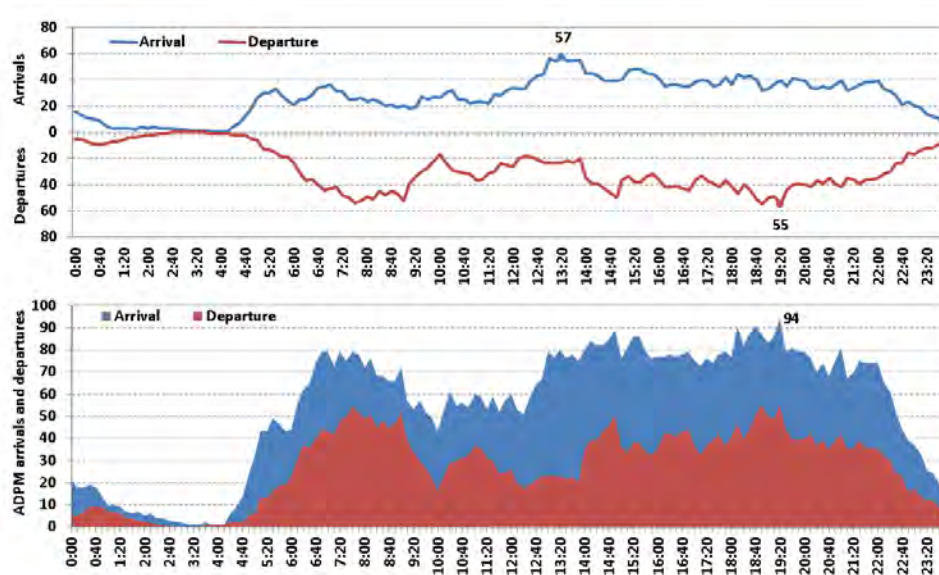


Figure 1: Example of a Typical 24-hour Traffic Profile (rolling-hour)¹

b. DDFS Package 2: Original Schedule files

1. Information/Data to be included for each flight:
 - i. Air Carrier name and IATA code
 - ii. Aircraft equipment
 - iii. Seat capacity

¹ This figure is provided for illustration purposes only. The information and values included in it are not actual data and should not be used as part of any development project. Source: Port Authority of New York and New Jersey

- iv. Arrival and departure time and day (Port Authority standard DDFS is a 3-day paired flight schedule, that includes at a minimum, arrivals on Day 1, arrivals/departures on Day 2, and departures on Day 3)
- v. Arrival and departure flight numbers (or identifiers)
- vi. Origin and destination airports (or identifiers)
- vii. Gate assignment
- viii. Hardstand assignment
- ix. For arrivals: deplaning, terminating and transfer passengers
- x. For departures: enplaning, originating and transfer passengers

Accepted Format(s): Microsoft Excel file (see sample Figure 2). Each flight schedule should be submitted in a different file and should be clearly labeled with the corresponding milestone year.

B	D	E	F	G	H	I	J	K	M	N	Q	R			
Published	Carrier	Equipment	Seat	Confi	ArrOrigin	ArrFlight	Number	ArrSchTime	DepDestinatio	Number	DepSchTime	Operation	PubCarrName	ArrSector	DepSector
	2D	B-767-200	210	PUJ	408	7/7/2016 02:45	PUJ	407	7/7/2016 06:10	Passenger		Passenger	Dynamic	Intl	Intl
	PS	B-767-300ER	255	KBP	231	7/6/2016 14:20	KBP	232	7/7/2016 00:30	Passenger		Passenger	Ukraine	Intl	Intl
	AA	B-757-200	176	MIA	1048	7/6/2016 16:58	STT	936	7/7/2016 09:15	Passenger		Passenger	American	Dom	Dom
	JL	B-787-8	186	NRT	4	7/6/2016 18:20	NRT	3	7/7/2016 09:40	Passenger		Passenger	Japan	Intl	Intl
	AA	B-757-200	176	STT	936	7/6/2016 19:02	SIJ	1357	7/7/2016 07:30	Passenger		Passenger	American	Dom	Dom
	DL	B-737-800	160	PHX	537	7/6/2016 19:28	MBJ	441	7/7/2016 09:05	Passenger		Passenger	Delta	Dom	Intl
	DL	ERJ-145	50	ACK	3301	7/6/2016 19:45	IAD	4210	7/7/2016 07:45	Passenger		Passenger	Delta	Dom	Dom
	DL	B-757-200WL	168	SFO	1583	7/6/2016 20:08	SFO	434	7/7/2016 09:30	Passenger		Passenger	Delta	Dom	Dom
	AA	B-737-800	160	PHX	2527	7/6/2016 20:30	ORD	2296	7/7/2016 07:35	Passenger		Passenger	American	Dom	Dom
	AA	B-757-200	184	MIA	2254	7/6/2016 20:31	CLT	1495	7/7/2016 08:29	Passenger		Passenger	American	Dom	Dom
	XL	B-767-300	238	GYE	538	7/6/2016 20:45	GYE	539	7/7/2016 01:15	Passenger		Passenger	LanEcuador	Intl	Intl
	DL	B-757-200WL	168	SAN	856	7/6/2016 20:50	LAX	422	7/7/2016 09:30	Passenger		Passenger	Delta	Dom	Dom
	DL	CRJ-900	76	ROC	4110	7/6/2016 21:00	YYZ	4067	7/7/2016 07:29	Passenger		Passenger	Delta	Dom	Intl

Figure 2: Example of a Typical Design Day Flight Schedule – Tabular Format ²

c. DDFS Package 3: Gate and Hardstand Utilization Chart (“Gantt Chart”)

1. Information/Data to be included for each gate and hardstand:
 - i. Design aircraft for each gate and hardstand
 - ii. International capability of gate (versus for domestic operations only)
 - iii. “Horizontal bars” representing gate occupancy time for each flight over a 24-hour period, including gate-in and gate-out times
 - iv. Indication on the type of operation (either departure/arrival or tow operation), usually depicted by a symbol
 - v. Indication on the buffer time used for each flight
 - vi. Air Carrier name (or IATA code)
 - vii. Aircraft equipment

² This figure is provided for illustration purposes only. The information and values included in it are not actual data and should not be used as part of any development project. Source: Port Authority of New York and New Jersey

Accepted Format(s): Microsoft Excel / Word / PowerPoint file, Adobe PDF (see sample below)

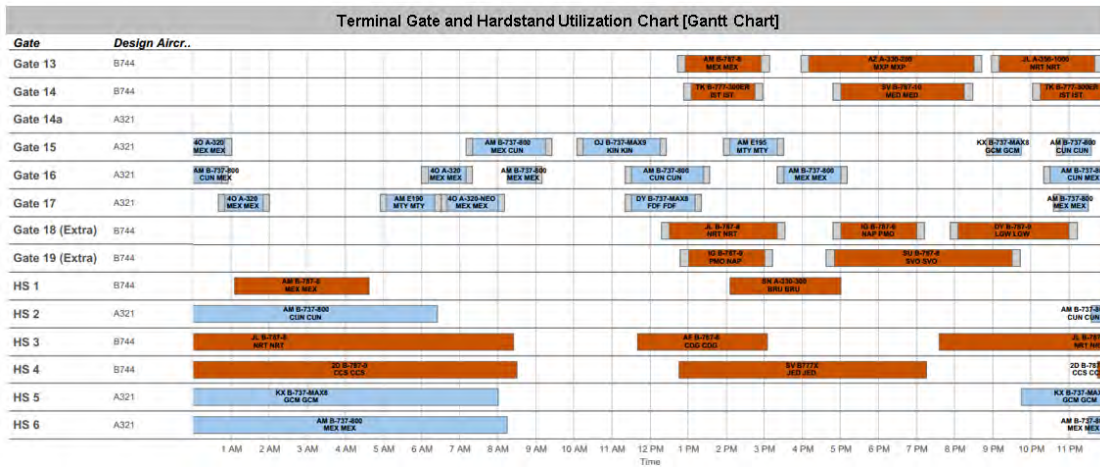


Figure 3: Example of a Typical Gate Utilization Chart – Gantt Chart Format³

Please refer to the following section of this document for methodology guidelines and parameters to be used to generate the gates and hardstands requirements.

Note: Sensitivity Analysis

Flight delays, common in long-haul flights, can drastically change airport activity, which is not captured in a planning day flight schedule. For this reason, the Port Authority may require additional sensitivity analysis on demand activity for specific projects, to incorporate delay factors in facility planning.

3. Airport Facility Requirements (Airside / Terminal / Landside)

The utilization of the planning data and information described in this document to generate existing and future airport facility requirements will be described in the subsequent sections: Airside, Terminal, and Landside Guidelines. Specific details and methodology guidelines will be provided for the planning and conceptual design of development projects at PANYNJ airports.

For the Gate and Hardstand requirements, it was decided to provide the methodology guidelines and parameters in this section, as the process is generally correlated with the development of the Design Day Flight Schedule.

Gate and Hardstands Requirement – Methodology and Assumptions

The computation methodology to generate gates and hardstands requirements must be fully documented as part of the proponent’s proposal.

The gating parameters and assumptions must be explicitly described in the proposal and summarized in a tabular format. The table below lists the mandatory parameters that need to be documented and

³ This figure is provided for illustration purposes only. The information and values included in it are not actual data and should not be used as part of any development project. Source: Port Authority of New York and New Jersey

provided to the Port Authority for review and approval. The table also provides the Port Authority Minimum Criteria for each gating parameter:

	Proponent's Planning Parameters (to be provided)	Minimum Planning Criteria*
Buffer Time (minimum time between two aircraft using the same gate)		
Regional Jets or Smaller Aircraft	-	15 minutes
All other Aircraft Design Groups if apron is equipped with dual taxilane or taxi-through taxilane and with sufficient on-site or close-in hardstand positions	-	15 minutes
All other Aircraft Design Groups	-	20 minutes
Shuttle operation	-	15 minutes
Minimum Aircraft Turnaround Time (minimum time between aircraft gate arrival time and gate departure time)		
ADG-II	-	30 minutes
ADG-III	-	45 minutes
ADG-IV	-	60 minutes
ADG-V	-	90 minutes
ADG-VI	-	105 minutes
Minimum Aircraft Unloading / Loading times (for towing operations)		
ADG-II	-	25min / 30min
ADG-III	-	30min / 45min
ADG-IV	-	45min / 60min
ADG-V	-	60min / 90min
ADG-VI	-	75min / 105min
Other Towing Parameters		
Towing Time (from/to Hardstand)	-	15 minutes
Minimum Ground Time on on-site or close-in hardstand position for ADG III or smaller	-	45 minutes
Minimum Ground Time on on-site or close-in hardstand position for all other Aircraft Design Groups	-	60 minutes
Minimum Ground Time on off-site Hardstand	-	90 minutes

* Consult with Port Authority Aviation Department for approval if any deviations from the above standards

Table 1: Ground Time Planning Criteria

In addition, detailed assumptions related to aircraft size considerations, airline assignments and other operational restrictions may be required by the Port Authority on a project basis.

For all proposed terminal developments, gate and hardstand requirements must be summarized for each planning horizon (year of commencement of operations, +5-year, +20-year) in a tabular format following the template below:

Contact Gates and Hardstands Summary – Proponent’s Plan (to be provided)						
	YEAR OF COMMENCEMENT OF OPERATIONS		+5-YEAR PLANNING HORIZON		+20-YEAR PLANNING HORIZON	
	Domestic	International	Domestic	International	Domestic	International
Contact Gates¹						
ADG-II (Regional Jets)	-	-	-	-	-	-
ADG-III	-	-	-	-	-	-
ADG-IV	-	-	-	-	-	-
ADG-V	-	-	-	-	-	-
ADG-VI	-	-	-	-	-	-
Total Contact Gates	-	-	-	-	-	-
Average Daily turns per Gate	-	-	-	-	-	-
Average Daily passengers per gate	-	-	-	-	-	-
Narrow Body Equivalent Gates (NBEG)	-	-	-	-	-	-
Hardstands / Parking Positions²						
ADG-II (Regional Jets)	-	-	-	-	-	-
ADG-III	-	-	-	-	-	-
ADG-IV	-	-	-	-	-	-
ADG-V	-	-	-	-	-	-
ADG-VI	-	-	-	-	-	-
Total Hardstands	-	-	-	-	-	-

Table 2: Contact Gates and Hardstands Summary - Template

Notes:

1. If the proposed development includes the use of MARS Gates (Multi-Aircraft Ramp System), they should be included in the table as a separate item. In addition, the aircraft layout and configurations of each proposed MARS gate must be submitted to the Port Authority for review and approval. Please refer to the Airside Standards section for more detail regarding MARS gate arrangements.

2. The above table considers that all hardstands and aircraft parking positions are independent. If the proposed plan includes inter-dependent parking positions, additional information will be required by the Port Authority as part of the proposal review process. In addition, for planning purposes, the use of live hardstands on a permanent basis is prohibited at PANYNJ airports. Any proposed plan considering the use of live hardstand operations must demonstrate the temporary need for them, by assessing all alternative options and justify that none of them meet the program’s objectives and requirements. Any

plan for live hardstand operations must be submitted to the Port Authority for review and approval in the early planning stages of the project. Please refer to the Airside Standards section for more detail regarding live hardstand operations.

4. Surveys and Data Collection

If the proponent is in a non-competitive position for expansion or redevelopment of an existing facility, they are responsible for conducting on-site surveys to confirm passenger characteristics that are specific and unique to each airport and terminal, including the following: landside modal split and dwell times, earliness distribution (“show-up profile”) of departing passengers arriving at the terminal before scheduled departure time, travel party size, percent of passengers checking bags, number of bags checked per passenger checking bags, terminal facility use and processing rates, load factors, and transfer percentages. The latter two must be specified by flight or time of day/flight type (i.e., Domestic vs International and aircraft size).

Some of this data can be collected from databases maintained by the Port Authority, terminal operators, and airlines as part of ongoing customer service monitoring. Gathering this data should be the designer’s first effort. For data that is not available from database sources, designers must carefully plan and execute on-site surveys at the terminal during peak demand periods. The survey methods can include active intercepts or passive observations of passengers, as appropriate. Active intercepts should be minimized to the extent practicable, because it causes an inconvenience to passengers.

For additional guidance on passenger surveys at airports, consult the Transportation Research Board (TRB) Airport Cooperative Research Program (ACRP) Report 26.

The proponent should coordinate the method, strategy, minimum acceptable sample sizes, and parameters for data collection with the Port Authority for review and approval, before starting any analysis.

If the survey is not conducted during peak periods, seasonality adjustments and factors on the data set need to be coordinated with the Port Authority to account for potential variations during peak periods.

SECTION II: AIRSIDE REQUIREMENTS

Part 1 - Airside Facility Requirements – Methodology Guidelines

1. Standards and References

Proposed developments should be compliant with all applicable industry codes, standards and regulations, including but not limited to the latest versions of the following documents:

- a. Federal Aviation Administration (FAA) Advisory Circulars (AC) and Orders
 1. AC 150/5220-21C: Aircraft Boarding Equipment
 2. AC 150/5300-13A: Airport Design
 3. AC 150/5300-14C: Aircraft Deicing
 4. AC 150/5320-5D: Airport Drainage Design Document Information
 5. AC 150/5340-1L: Standards for Airport Markings
 6. AC 150/5360-13A: Airport Terminal Planning
 7. Federal Aviation Regulations Part 107 – Airport Security
 8. Federal Aviation Regulations (FARS 14 CFR)
 9. FAA Order 8260.3B: US Standards for Terminal Instrument Procedures
 10. Applicable FAA Advisory Circulars
- b. Airport Cooperative Research Program (ACRP)
 1. ACRP Report 14 – Deicing Planning Guidelines and Practices for Stormwater Management Systems
 2. ACRP Report 25 - Volume 1: Airport Passenger Terminal Planning and Design
 3. ACRP Report 62 - Airport Apron Management and Control Programs
 4. ACRP Report 96 - Apron Planning and Design
- c. International Civil Aviation Organization (ICAO)
 1. ICAO Aerodrome Design Manual, Part 4: Visual Aids
 2. ICAO Annex 14, Volume I: Aerodrome Design and Operations
- d. International Air Transport Association (IATA)
 1. IATA Airport Development Reference Manual 10th Edition
- e. Port Authority of New York and New Jersey (PANYNJ) Standards
 1. PANYNJ Civil Engineering Design Guidelines
 2. PANYNJ Tenant Alteration Procedures and Standards Guide, December 20, 2013
 3. PANYNJ Tenant Construction Review Manual
- f. Airports Council International (ACI)
 1. Apron Markings and Signs Handbook, Third Edition, 2017
- g. United States Customs and Border Protection
 1. Airport Technical Design Standards (2017)

- h. National Safe Skies Alliance
 - 1. PARAS 0004 - Recommended Security Guidelines for Airport Planning, Design, and Construction 2017
- i. Americans with Disabilities Act (ADA), 2012 (or latest)
 - 1. Title III (28 CFR Part 36) ADA – ADOPTED July 1, 1994 (Updated September 15, 2010)
 - 2. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
 - i. ADAAG published in 28 CFR Part 36 Federal Register
 - ii. ADAAG for Titles I (Employees) and III (Public Accommodation)
- j. Code of Federal Regulations (CFR)
 - 1. CFR Title 14, Part 77: Safe, Efficient Use, and Preservation of the Navigable Airspace
- k. Green Building Council (USGBC)
 - 1. Leadership in Energy and Environmental Design (LEED) New Construction Version 4.0
- l. Illumination Engineering Society of North America (IESNA)
 - 1. IES Handbook 10th Edition
 - 2. RP 37-15 Outdoor Lighting for Airport Environments
- m. International Building Code (IBC)
- n. International Fire Code (IFC), 2010
- o. National Electric Code (NEC), 2011
- p. National Transportation Communications for Intelligent Transportation Systems Protocol (NTCIP) Standards:
 - 1. NTCIP 1201 Global Object Definitions,
 - 2. NTCIP 1203 Object Definitions for Dynamic Message Signs
- q. National Fire Protection Association (NFPA)
 - 1. NFPA 101: Life Safety Code, 2006
 - 2. NFPA 110: Standard for Emergency and Standby Power Systems
 - 3. NFPA 407: Standard for Aircraft Fuel Servicing
 - 4. NFPA 415: Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways
- r. Occupational Safety and Health Administration (OSHA)
 - 1. 29 CFR Part 1910 -211 (Definitions)
 - 2. 29 CFR Part 1910 – 212 (General Industry Standards and Requirements)
- s. All applicable federal, state and local codes

The following codes are applicable to projects in New York City only:

- a. New York City Building Code (NYC BC)
- b. New York City Department of Environmental Protection (NYC DEP)
- c. New York City Electrical Code
- d. New York City Fire Code (NYCFC), 2008

The following codes are applicable to projects in New York State only:

- a. New York State Department of Transportation

The following codes are applicable to projects in the State of New Jersey only:

- a. International Building Code (IBC), New Jersey edition, 2009
- b. International Fire Code, (IFC) New Jersey Edition 2006
- c. New Jersey Uniform Fire Code NJAC 5:70

When there is a conflict or discrepancy between two reference standards from different sources or documents listed above, the more stringent requirements shall apply.

2. Units

All structures shall be designed and detailed using Customary U.S. Units.

3. Datum

- a. Vertical Control: NAVD88
- b. Horizontal Control: State Plane NAD83

4. Contact Gates and Hardstands

The computation methodology to generate gates and hardstands requirements must be documented as part of the proponent's proposal, including all gating and towing parameters. Please refer to the section on Forecast and Future Demand for detailed guidance on the methodology and parameters to be used at PANYNJ airports.

Part 2 - Airside Concept of Operations

The following Concept of Operation plans and operational information must be provided to the Port Authority for any proposed airside development at PANYNJ airports:

1. Gates and Hardstands Usage

The proposed plan must illustrate and identify the following characteristics at each contact gate:

- Airlines common-use, versus Exclusive/preferential use
- Capability to accommodate international operations, versus domestic only
- Multi-Aircraft Ramp System (MARS) gates

For hardstands, the Port Authority recommends the design for independent parking positions. If inter-dependencies exist between hardstands, they must be identified in the plan.

2. General Aircraft Circulation/Movements Plan

- a. The apron concept of operations plan must include at a minimum the following elements and details:
 1. Taxilane alignment and marking:
 - i. Pavement marking centerline
 - ii. Pavement marking hold bars
 - iii. Hold position lights
 2. Aircraft ground flows on proposed taxilanes
 3. General pushback maneuvering and engine startup position locations and utilization, including jetblast analysis from startup to entrance to the airfield.
 4. Interface with Airfield: proposed aircraft sequencing at each apron entrance/throat (e.g., arrival priority versus departure priority, typical holding times)
- b. Aircraft pushback maneuvering and other apron operations shall be contained within the limits of the non-movement area. The Port Authority should be consulted if the proposed plan has impacts on the movement area.
- c. As part of the proposal review process, the Port Authority may require additional details if needed to ensure safe and efficient aircraft movements on the apron.
- d. Off-site Aircraft Parking:
 1. If remote parking positions are considered off-site (outside of tenant's leasehold), detailed aircraft ground flow maps showing towing operations on taxiways from on-site gate/hardstand to off-site parking positions must be provided to the Port Authority for review and approval.



Figure 4: Aircraft Pushback Maneuvering

3. Detailed Aircraft Maneuvering Plan for each contact gate and aircraft parking position

- a. Detailed aircraft maneuvering plans, including power-in and pushback operations must be provided for each gate and hardstand position to the Port Authority for review and approval.
- b. Computer simulation software such as PathPlanner Airside, and AviPlan must be used for aircraft maneuvering simulations. Files of the maneuvering drawings must be provided to the Port Authority for review.
- c. As part of the proposal review process, the Port Authority may require additional information on specific gates and/or hardstands.

Part 3 - Site Planning Criteria

In developing site layouts for new facilities, the applicant should be aware that building and paving set back limits exist but vary depending on the type of airport, location within the airport boundary, and adjacent jurisdictions. The main goals of these setbacks include, but are not limited to, establishing right-of-way easements including fire equipment access around structures and utility / infrastructure access. Setbacks are also essential to retain a feeling of open space, integration with adjacent parkways, for aesthetic considerations, and meeting the required local ordinances for New York and New Jersey.

General landscaping for the area includes programming for flood resistance, stormwater absorption, infiltration, and treatment. Bioswales, plantings for ground cover, screening of elements and for accent shall be planned for the open areas. Refer to the Port Authority Sustainable Infrastructure Guidelines⁴, for additional information.

In addition to setback defined in this section appropriate clearances from airside security fencing shall be maintained.

When there is a conflict or discrepancy between two standards, the more stringent requirements shall apply.

1. Setback Requirements for Property Leaselines

The following minimum standards shall be maintained for property lease line setbacks based on hierarchy of roadway types:

a. High-speed Expressways / Highways

New leaselines adjacent to high-speed expressways / highways shall maintain a minimum offset of 100 feet measured from the inner curbline of roadway. See Figure 5: Lease line setback at High-speed Expressways / Highways



⁴ PANYNJ Sustainable Infrastructure Guidelines, March 23, 2011 Appendix 06: Aviation Landscape and Sustainable Design Criteria, Engineering Department, PANYNJ, March 17, 2010

Figure 5: Lease line setback at High-speed Expressways / Highways

b. Primary Entrance / Exit Roadways:

New leaselines adjacent to primary / main access roads shall maintain a minimum offset of 25 feet measured from the inner curbline of roadway. See Figure 6: Lease line setback at primary / main access roadways

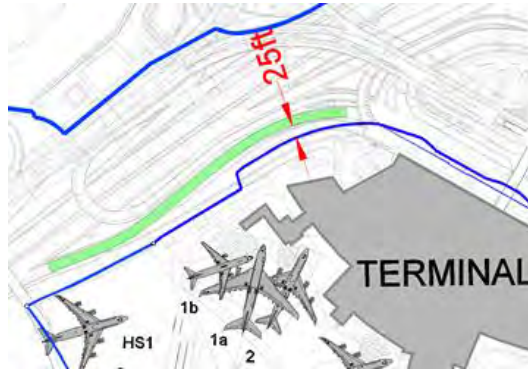


Figure 6: Lease line setback at primary / main access roadways

c. Secondary Roadways:

New leaselines at secondary roads shall maintain a minimum offset of 15 feet measured from the inner curbline of roadway. See Figure 7: Lease line setback at secondary roadways

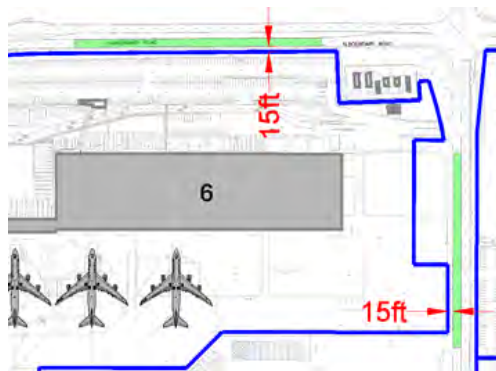


Figure 7: Lease line setback at secondary roadways

d. Airside Restricted Service Roads:

New leaselines at airside restricted service roads shall maintain a minimum offset of 10 feet measured from the inner edge of airside restricted service road (Port Authority service road). See Figure 8.



Figure 8: Lease line setback at airside restricted service roads

2. Setback Requirements for New Structures and Utilities

The following minimum standards shall be maintained for new structures and utilities setbacks:

a. Buildings / Structures:

New buildings or structures must comply with the following setback requirements whichever is greater 50 feet or more from lease line at primary or secondary roadways. See Figure 9.



Figure 9: Building / Structure setback from lease line at primary / secondary roadway

30 feet or more from lease line of adjacent property or local access roadway. See Figure 10.

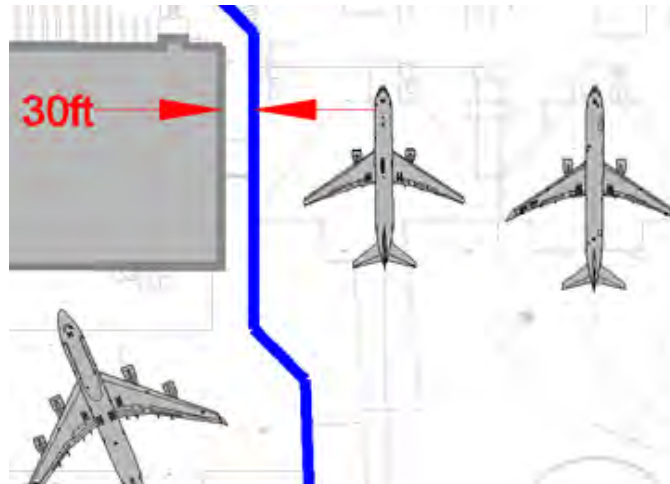


Figure 10: Building / Structure setback from lease line of adjacent property or access roadway

b. Auto parking

At grade auto parking lots must comply with the following setback requirements. See Figure 11.

1. 35 feet or more from any expressway and primary roadway (median consisting of a single row of trees, low hedge and security fence).
2. 30 feet or more from any secondary roadway.



Figure 11: Auto parking lots setbacks from primary and secondary roadways

c. Utilities Easement:

Utilities easement requirements will be reviewed on case by case basis.

3. AirTrain

Consult the Port Authority Rail Operations group at each airport for minimum clearances to be maintained from existing AirTrain (automated people mover) systems at John F. Kennedy and Newark Liberty International airports.

4. Security

There are numerous advantages to incorporating security concerns into the airport planning and design process at the earliest phases of planning and development. Timely consideration of such needs will result in less obtrusive, less costly, and more effective and efficient security systems⁵.

General planning, design, construction, and operational requirements of a commercial airport are established and overseen by the FAA under airport certification requirements identified in 14 CFR § 139. Approaches to physical security should reflect applicable federal, state, and local laws, regulations, and policies to ensure the protection of all persons and assets.

a. Security-Specific Reference Documents

- *PANYNJ Security Manual*
- *ACRP - Assessment of Technologies Deployed to Improve Aviation Security: First Report*
- *FAA AC 150/5300-13 - Airport Design*
- *FAA AC 150/5360-13 - Planning and Design Guidelines for Airport Terminal Facilities*
- *Safe Skies PARAS 0004 - Recommended Security Guidelines for Airport Planning, Design, and Construction*
- *ACI Landside Security Handbook, First Edition*

b. General Airport Security Guidelines and State of The Practice

General planning, design, construction, and operational requirements of a commercial airport are established and overseen by the FAA under airport certification requirements identified in 14 CFR § 139. Ensuring the inclusion of security systems, methods, and procedures within this construction and operational process is a joint responsibility of the airport and the TSA.

c. Air Operations Area (AOA) Perimeter Fencing and Access Posts

To delineate and adequately protect the Air Operations Area (AOA) from unauthorized access it is important to consider boundary measures such as fencing, walls, or other physical barriers, and electronic boundaries (e.g., sensor lines and alarms) in the planning and design process. Access points for personnel and vehicles through the boundary lines, such as gates, doors, guard stations, and electronically controlled or monitored portals, should also be considered.

Regardless of boundary location or type, the number of access points should be minimized for both security and cost efficiency. Proper planning and design can often create fewer, more functional and maintainable access points that will benefit the airport in the long run.

Physical barriers can be used to deter and delay the access of unauthorized persons into nonpublic areas of airports. These are usually permanent barriers and designed to be an obvious visual barrier as well as a physical one. Where possible, security fencing should be aligned with security area boundaries. Some types of fencing are difficult to climb or cut, and many uses such technologies as motion, tension, or other electronic sensing means. When fences have sensors, either mounted on the fencing or covering

⁵ Safe Skies PARAS 0004

areas behind fencing, they must be accommodated in the security system to monitor the sensors and to initiate response to intrusion alarms.

Chain link fencing is the most common and cost-effective type of fencing for deterrence, as opposed to the prevention of forced entry. The FAA Advisory Circular recommends chain link fences to be constructed with seven feet of fabric plus one or more coils of stranded barbed wire on top, which may be angled outward at a 45-degree incline from the airside. Fabrics should be secured to the fence posts and to the bottom rail in a manner that makes it difficult to loosen the fabric.

Clear distances of 10 feet must be maintained on both sides of AOA fence, within which there should be no climbable objects, trees, or utility poles abutting the fence line, nor areas for stackable crates, pallets, storage containers, or building materials. Likewise, service roads and parking of vehicles along the fence within the 10-foot buffer is prohibited. Landscaping within the clear zone should be minimized or eliminated to reduce potential hidden locations for persons, objects, fence damage, and vandal.

Additional security measures to consider that would enhance these boundaries and access points are security lighting, video surveillance systems, and signage.

d. Physical Hardening Methods

While it is not possible to fully protect passengers and facilities from an explosive attack, there are measures that can be put in place that can either reduce the potential for an attack or reduce the effectiveness of such an attack. The following is a brief overview of methods and materials that can be employed to physically protect the airport and its various components.

1. Bollards

A bollard is a vehicle barrier consisting of a cylinder, usually made of steel and filled with concrete placed on end in a deep concrete footing in the ground to prevent vehicles from passing, but allowing the entrance of pedestrians and bicycles. Bollards are also constructed of steel sections and reinforced concrete. An anti-ram bollard system must be designed to effectively arrest the vehicle and its cargo as quickly as possible and not create an opening for a second vehicle. Bollards can effectively protect facilities and columns from vehicular impact and bomb blasts by creating standoff between the target and the threat.

A typical fixed anti-ram bollard consists of a ½-inch thick steel pipe, eight inches in diameter projecting about 30 inches above grade and buried about 48 inches in a continuous strip foundation.

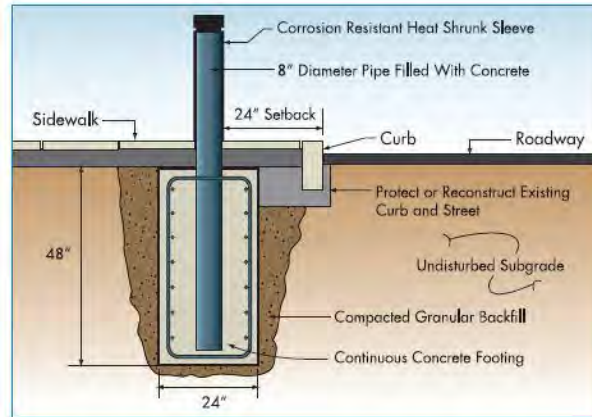


Figure 12: Typical Fixed Bollard installation⁶

Bollards are, by their nature, an intrusion into the streetscape. A bollard system must be very thoughtfully designed, limited in extent and well-integrated into the perimeter security design and the streetscape in order to minimize its negative visual impact. The design basis threat, in terms of vehicle size and speed, influences bollard height and construction material. Typically, bollards should not exceed a height of 38 inches inclusive of any decorative sleeve.

e. Building and Parking Setbacks

The landside is the area of an airport, including buildings and other structures, to which both traveling passengers and the non-traveling public have unrestricted access. Examples of landside facilities are public and employee parking, terminal and public roadways, rental car and ground transportation operations, hotel facilities, and commercial and industrial developments. The publicly accessible areas of terminal buildings are technically considered part of landside and have several security-related considerations that should be planned in conjunction with other landside facilities.

Security in landside areas is difficult to monitor and control due to public accessibility and the limitations of implementing security measures—often over varied terrain, or in some cases urban settings immediately adjacent to airport properties. There are many issues to address while keeping focused on terminal design, passenger throughput, aircraft operations, and the generation of revenues.

1. Landside Roads

When planning landside roadways, attention should be given to adjacent security fencing, airside access, and potential threats to terminal or aircraft operations. Designers should bear in mind landside road proximity to security fencing, the potential for unauthorized airside access offered by elevated roadways, and line-of-sight threats to adjacent areas of the terminal, apron, and/or nearby aircraft.

Drop-off and loading zones should be set as far away from the terminal as practical to minimize the blast effects of a vehicle bomb.

⁶ US Department of State

Planners should provide for emergency vehicle (fire and police) parking and staging areas near the terminal, potential inspection areas, and congested areas.

During periods of heightened security, planners should ensure vehicles cannot gain access to the terminal by bypassing the inspection area; and scenarios should be evaluated such as the potential to jump curbs, travel across open landscaping, or drive the wrong way down a road.

2. Landside Parking

Parking area entrances and exits should not be placed directly in front of the terminal. Elevated security levels may require inspections of vehicles entering and exiting parking facilities.

During periods of heightened security, designs should accommodate permitting vehicle access only after a detailed inspection process, closing parking areas off, or segmenting them to control access only by authorized personnel such as employees, first responders, or other known entities.

Planners should provide sufficient space in parking areas to facilitate the movement of police, fire, and emergency vehicles, as well as turning radius accommodations for tow trucks for removal of suspicious or abandoned vehicles.

Parking facilities shall be designed to have parked vehicles be more than 300 feet from nearest terminal building. Locating parked vehicles less than 300 feet from terminal may require development of local security plan based on approved blast analysis performed by a certified engineering firm and is to be instituted during periods of heightened security.

Truck access and loading docks present challenges to the landside protection of airports. Roadway access should be developed to limit unscreened trucks from accessing the landside frontage of the terminal. Delivery trucks should be identified and screened prior to having access to the terminal.

5. Phasing Criteria & Concepts

[Section under development]

6. Land Use and Zoning

[Section under development]

7. Line of Sight Requirements for the Airport Traffic Control Tower

This section describes line-of-sight (LOS) requirements for FAA Air Traffic Control (ATC) staff from the Airport Traffic Control Tower (ATCT). FAA ATC staff are responsible for the life-safety critical task of directing aircraft in the airspace and on the airfield in a safe and efficient manner, and their unobstructed view of the airfield is therefore of utmost importance.

a. Reference Documents

- *FAA Order 6480.4A - Airport Traffic Control Tower Siting Process*
- *Title 14 US Code of Federal Regulations (CFR), Federal Aviation Regulations (FAR) Part 77 – The Safe, Efficient Use, and Preservation of the Navigable Airspace*
- *FAA AC 150/5300-13A - Airport Design*

b. Airport Traffic Control Tower Line of Sight

FAA Order 6480.4A covers both the designing and sighting of a new ATCT as well as maintaining an unobstructed view of all movement areas on the airfield when a new development is proposed that could hinder the views of the FAA ATC staff in the ATCT.

Whenever there is new development project or addition to existing facility are proposed, that could hinder the views of the FAA ATC staff in the ATCT, a Visibility Siting Analysis shall be conducted to address the Unobstructed View requirements. The developer must submit a Visibility Siting Analysis along with plans and section views to the Port Authority for review and approval.

1. Unobstructed View

Port Authority requirement is for controllers in an ATCT cab to have an unobstructed view of all controlled movement areas including all runways, taxiways, and any other landing areas, and of air traffic in the vicinity of the airport. It is a Port Authority requirement for the FAA ATC staff to have a view of all pavement surfaces (edge to edge) from the ATCT. The simulation tool at Airport Facilities Terminal Integration Laboratory (AFTIL) located at the William J. Hughes Technical Center shall be used to do a dynamic visibility analysis including the evaluation of both moving and parked aircraft.”

The line of sight analysis (LOS) shall account for all existing portions of the airfield, as well as future planned modifications, including but not limited to: new or extended runways; new, extended, or adjusted taxiways and hold bays. Consult the latest approved ALP, as well as the Port Authority, for future airfield modifications that must be included in the LOS analysis and future movement area changes that may be implemented to address existing FAA Modification of Standards.

8. Runway Protection Standards

The Federal Aviation Administration (FAA) sets forth multiple guidelines for protecting the safe and efficient operations of aircraft on runways, with geometric and land use restrictions and airspace protection designed to protect aircraft operations and ground infrastructure. Terminal Developers must adhere to FAA airport design guidance with any airport development proposal. Failure to do so will result in rejection of development proposals; and if constructed would result in hazardous conditions.

a. References

Airport planners and designers should be familiar with the following reference documents, which are discussed in more detail in the following sections:

- Title 14 of the US Code of Federal Regulations (CFR), Federal Aviation Regulations (FAR), Part 77, *The Safe, Efficient Use and Preservation of the Navigable Airspace*
- FAA Order 7400.2, *Procedures for Handling Airspace Matters*
- FAA Order 8260.3, *United States Standard for Terminal Instrument Procedures (TERPS)*
- FAA Advisory Circular 150/5300-13, *Airport Design*
- Airport Cooperative Research Program (ACRP) Report 38, *Understanding Airspace, Objects, and Their Effects on Airports*

9. Modification of Standards

The FAA has established a system of airport design standards in Advisory Circular (AC) 150/5300-13, *Airport Design*, and related ACs and Orders. These serve as a framework for developing and maintaining safe, orderly, and consistent airport facilities nationwide, and are utilized in FAA reviews of proposed projects at airports. When an airport project proponent (e.g. airport sponsor, tenant, developer, etc.) proposes a project that would not be in compliance with a particular airport design standard, the proponent can appeal to the FAA for a special exception to the standard, known as a Modification of Standards or “MOS”. The FAA’s review and decision regarding an MOS will be recorded in a letter from the FAA describing the condition and reasons for approval or disapproval, and should be recorded on the subsequent update to the Airport Layout Plan (ALP) drawings.

The FAA’s definition of MOS is as follows:

Any deviation from, or addition to standards, applicable to airport design, material, and construction standards, or equipment projects resulting in an acceptable level of safety, useful life, lower costs, greater efficiency, or the need to accommodate an unusual local condition on a specific project through approval on a case-by-case basis.⁷

In addition to new construction, an MOS can also be granted by the FAA for a “grandfathered” condition. This occurs when airport design standards change, legacy facilities do not comply to the new standards, and it would be technically or financially infeasible to bring the facilities into compliance with the new standards in the immediate term. In these cases, the MOS may be granted by the FAA, with time limit and/or facility reconstruction triggers that obligate the airport to bring the condition into compliance at some point in the future.

b. Design Approach and Review Process

In general, proponents should plan and design projects such that they will be in compliance with all FAA airport design standards. An MOS should be considered a rare exception, acceptable only in cases when there is no feasible way to comply with a particular standard, and equivalent level of safety can be demonstrated by the proponent and agreed by the FAA.

Because FAA approval is uncertain, proponents wishing to be granted an MOS should begin the application process early in the planning phases of a project. Proponents should first consult with Port Authority for an initial assessment.

The FAA’s mechanism for reviewing airport standards compliance is via ALP update, and may also include review via FAA Form 7460-1, *Notice of Proposed Construction or Alteration*. The Port Authority Tenant Construction and Alteration Process (TCAP) Manual specifies how and when in the Tenant Alteration Application (TAA) process a project which may trigger an ALP update is required to do so, as well as submitting Form 7460-1. In the TCAP Manual, there is an internet link to a checklist of project types which may require an ALP update, and similar link to the checklist for Form 7460-1 submittal.

⁷ FAA Order 5300.1, *Modifications to Agency Airport Design, Construction, and Equipment Standards*

Proponents whose projects may trigger an ALP update, whether or not it contains an MOS, must coordinate with Port Authority on which ALP drawing(s) should be included in the ALP update, and how it is to be submitted to the FAA for review. In cases where an MOS is requested from the FAA, in addition to the ALP drawings depicting the proposed condition, documentation supporting the rationale for the MOS must be provided for FAA review.

Depending on the nature of the MOS and which airport design standard(s) are affected, the FAA may require any or all of the following:

- Full ALP drawings and/or larger scale detail drawings showing the FAA standard vs. proposed MOS condition. Detail drawings at a larger scale are recommended to illustrate the condition fully.
- Citations from AC 150/5300-13 and other ACs and Orders describing the design standard(s) and their rationale(s).
- Detailed explanations of why compliance with the design standard in question would be infeasible.
- Viable options considered for potential alternative designs, and the rationale for selection of the preferred alternative.
- Evidence and analyses demonstrating how an equivalent level of safety is achieved (e.g. operational restrictions) by the preferred alternative. This could include safety risk assessments, manufacturer's literature, and/or FAA Engineering Briefs (EBs).
- Precedents of previous similar MOS.
- Submission of FAA Form 7460-1.
- Other supporting documentation as may be requested by Port Authority or the FAA.

Please refer to FAA AC 150/5300-13 and FAA Order 5300.1 for additional detail.

The proponent must submit all of the above documentation to Port Authority for review before submitting to the FAA. Port Authority will then coordinate with the FAA on submittal of the ALP drawings, detail drawings, and supporting MOS documentation.

If granted an MOS with a limited timeframe, e.g. full compliance with the standard is required in a certain number of years, proponents are responsible for providing full compliance with the timeframe specified by the FAA.

This section will be supplemented in future versions of this standards manual.

Part 4 - Conceptual Design Criteria

1. Design Aircraft and Fleet Mix

Any proposed plan for airside and terminal development at PANYNJ airports must explicitly indicate the critical aircraft and/or fleet mix considered for the design of each airside element, including:

- a. Contact Gates and Hardstands:
 1. Design aircraft per gate and hardstand (larger aircraft in terms of wingspan), and associated Aircraft Design Group (ADG);
 2. Comprehensive aircraft service chart, in a tabular format, providing the full list of aircraft that each contact gate and hardstand can accommodate.
- b. Taxilane Design:
 1. Critical aircraft and/or ADG used for each taxilane in order to define the following clearances (as per FAA AC 150/5300-13A: "Airport Design"):
 2. Taxilane centerline to parallel taxilane centerline;
 3. Taxilane centerline to fixed or moveable objects (object free area).

The critical aircraft and fleet mix used for the design of Aircraft Layout Plans must be consistent with the forecast and future demand scenarios provided to the Port Authority.

The aircraft layout plan shall incorporate as much flexibility as possible in terms of apron size and configuration in order to potentially accommodate, when feasible, aircraft/activity outside of the forecasted fleet (larger or smaller).

2. Geometric Design Criteria

The proponent's plan must precisely indicate the geometric design criteria used for airside elements based on the Design Aircraft and Fleet Mix submitted to the Port Authority for review and approval.

a. Apron Depth:

Adequate apron depth must be provided to fully accommodate parked aircraft within the apron area. Based on the proposed apron configuration, the Apron Depth is defined as follows:

1. For aprons with both a tail-of-stand (TOS) and a head-of-stand (HOS) roads: distance from edge of HOS to edge of TOS;
2. For aprons with no tail-of-stand road: distance from edge of HOS to the tail of the design group aircraft, plus 5 feet;
3. For aprons with no head-of-stand road: distance from edge of apron (edge of terminal building plus 10 feet) to the edge of TOS.

The following table lists the Port Authority Minimum Criteria for any proposed airside development at PANYNJ airports:

Port Authority Minimum Standards – Apron Design			
	Apron Depth	Aircraft Nose to Head-of-Stand road or edge of apron*	Aircraft Nose to Building
ADG-II (Regional Jets)	175 feet	24 feet	34 feet
ADG-III	175 feet ¹	24 feet	34 feet
ADG-IV	230 feet	24 feet	34 feet
ADG-V	275 feet ²	27 feet	37 feet
ADG-VI	275 feet ³	27 feet	37 feet

Notes:

- * Edge of apron is defined as edge of terminal building plus 10 feet
- 1. If MD90 aircraft including in fleet mix, use 180 feet
- 2. If A340-600 used in fleet mix, use 280 feet
- 3. If B747-8 and/or B777-9X included in fleet mix, use 285 feet
- 4. As new, longer aircraft might have come to market after the release of this manual, the developer should always ensure that the apron depth is not less than the design aircraft length, plus the distance shown in the “Aircraft Nose to Head-of-Stand road” column, plus an additional tail clearance of 5 feet. For aprons with no head-of-stand road, the apron depth should not be less than the design aircraft length, plus the distance shown in the “Aircraft Nose to Building” column, plus an additional tail clearance of 5 feet.

Table 3: PA Minimum Standards for Apron Design

b. Aircraft Clearances

Adequate aircraft clearances must be provided in order to ensure safe and efficient apron operations for aircraft maneuvering and servicing. The table below lists the Port Authority Minimum Criteria for any proposed airside development at PANYNJ airports:

Port Authority Minimum Standards – Aircraft Clearances on Apron						
	Parked Aircraft (stationary)			Aircraft in Motion ³		
	Wingtip Clearance between Parked Aircraft	Wingtip Clearance to Airport-Wide Service Road ¹	Distance between Aircraft and Tail-of-Stand or any other apron road ²	Wingtip Clearance to any fixed or movable object/vehicle Aircraft on Taxilane <i>(FAA AC 150/5300-13A, Table 4-1)</i>	Wingtip Clearance to any fixed or movable object/vehicle Aircraft on its own power between Taxilane and Gate [power-in]	Wingtip Clearance to any fixed or movable object/vehicle Tow operations only [pushback/tow-in] Aircraft not on its own power and with Wing Walkers
ADG-II (Regional Jets)	25 feet	10 feet	5 feet	18 feet	25 feet	15 feet
ADG-III	25 feet	10 feet	5 feet	22 feet	25 feet	15 feet
ADG-IV	25 feet	10 feet	5 feet	27 feet	25 feet	15 feet
ADG-V	25 feet	10 feet	5 feet	31 feet	25 feet	15 feet
ADG-VI	25 feet	10 feet	5 feet	36 feet	25 feet	15 feet

Table 4: PA Minimum Standards for Aircraft Clearances

Notes:

1. Airport-wide service roads are generally used by all ground vehicles at the airport, and can be either located in the movement or non-movement area. Please consult Port Authority before starting any analysis in order to identify the portions of the airport-wide service road that may be impacted by the proposed developments.
2. Apron service roads are primarily used by ground service equipment in close proximity of the contact gates and hardstands they are serving. Apron service roads are located within the non-movement area, and are usually not controlled by the Air Traffic Control tower.
3. Aircraft maneuvering plans must be submitted to the Port Authority in order to review and approve the proposed plans' compliance with these minimum standards. Please refer to the concept of operations section for further guidance on the development of the maneuvering plans.

c. Aircraft Safety Envelope and Jet Engine Intake Zone

Aircraft safety envelopes define the areas where no vehicles or GSE should be positioned unless they are specifically servicing the aircraft occupying that particular gate. The area outside of the aircraft parking and service envelopes and outside of the passenger boarding bridges (PBB) operational ranges, up to the building face, can be used for GSE parking and storage and other apron activities.

The envelopes should accommodate a safety zone around jet engine intakes to avoid adverse engine suction on personnel and equipment. Aircraft manufacturers provide information on the recommended safety zones around engines when idling. These markings are typically solid red bordered in white to provide additional contrast between the marking and the pavement. Many cargo operators use only white markings to identify the aircraft safety envelope. 10 feet is the minimum distance that the safety envelopes should protect from any point on the aircraft.

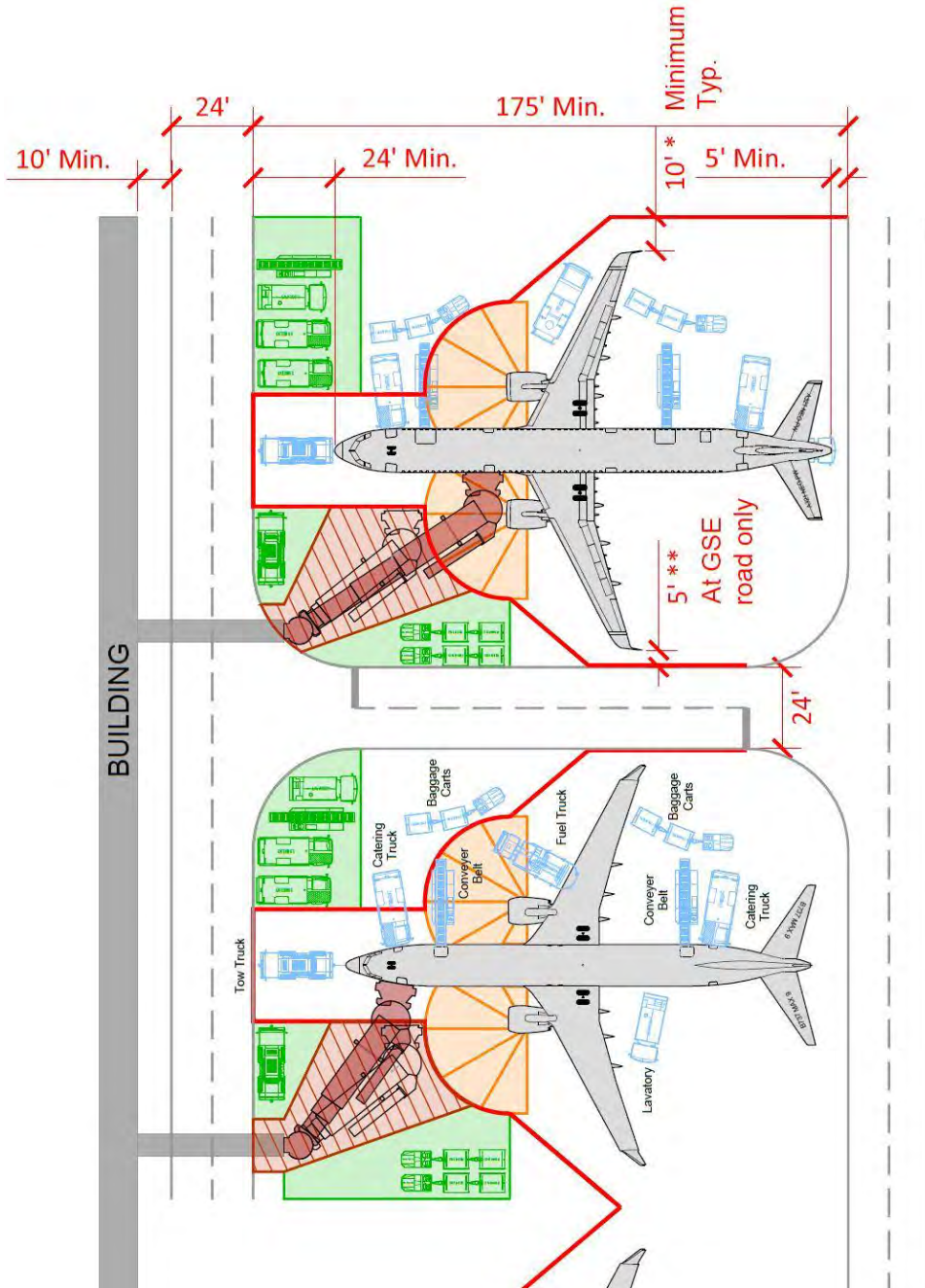


Figure 13: Typical Gate Layout for Group-III Aircraft (with head-of-stand road)
 [The figure is given for illustration purposes only]

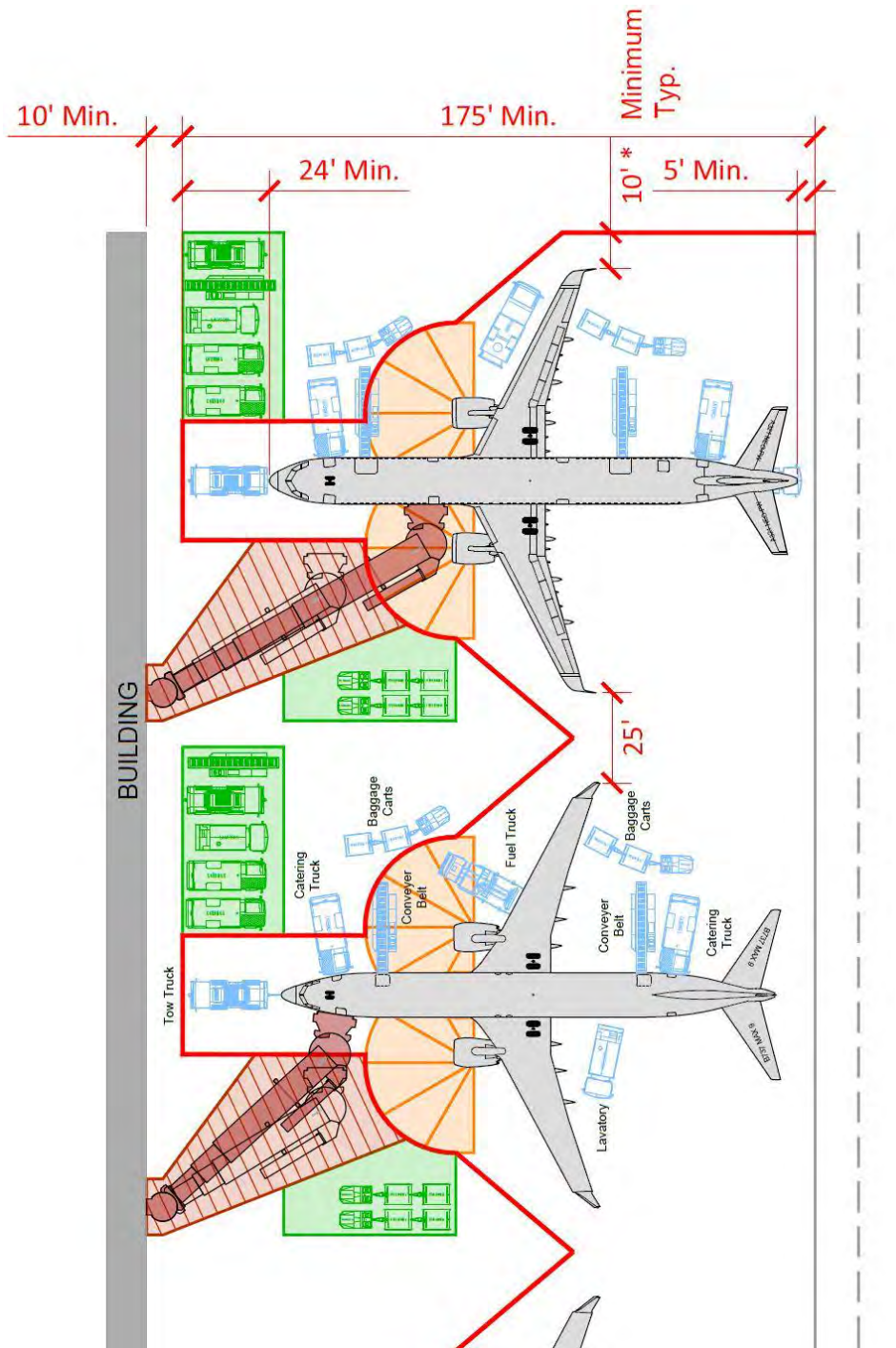


Figure 14: Typical Gate Layout for Group-III Aircraft (without head-of-stand road)
 [The figure is given for illustration purposes only]

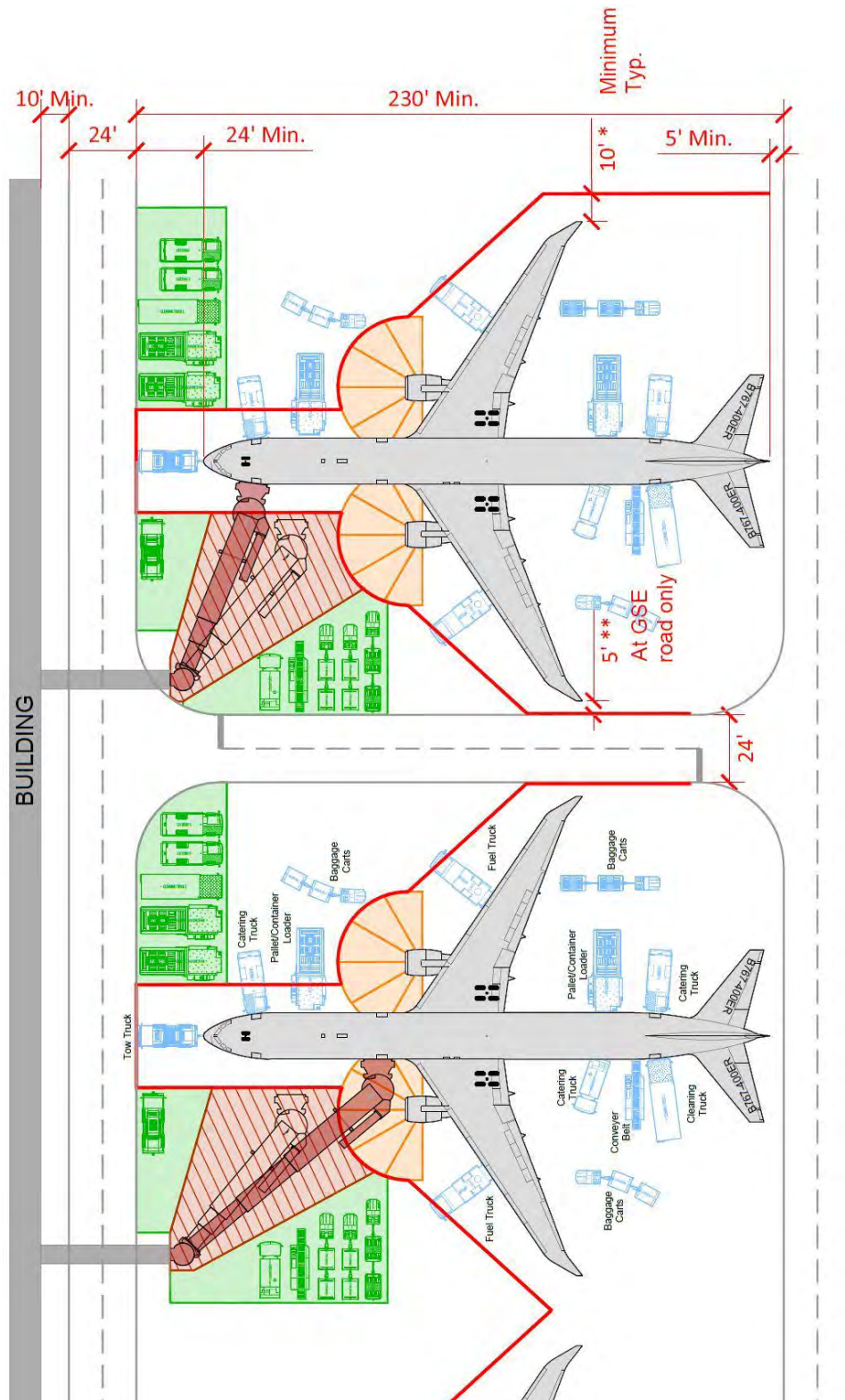


Figure 15: Typical Gate Layout for Group-IV Aircraft (with head-of-stand road)
 [The figure is given for illustration purposes only]

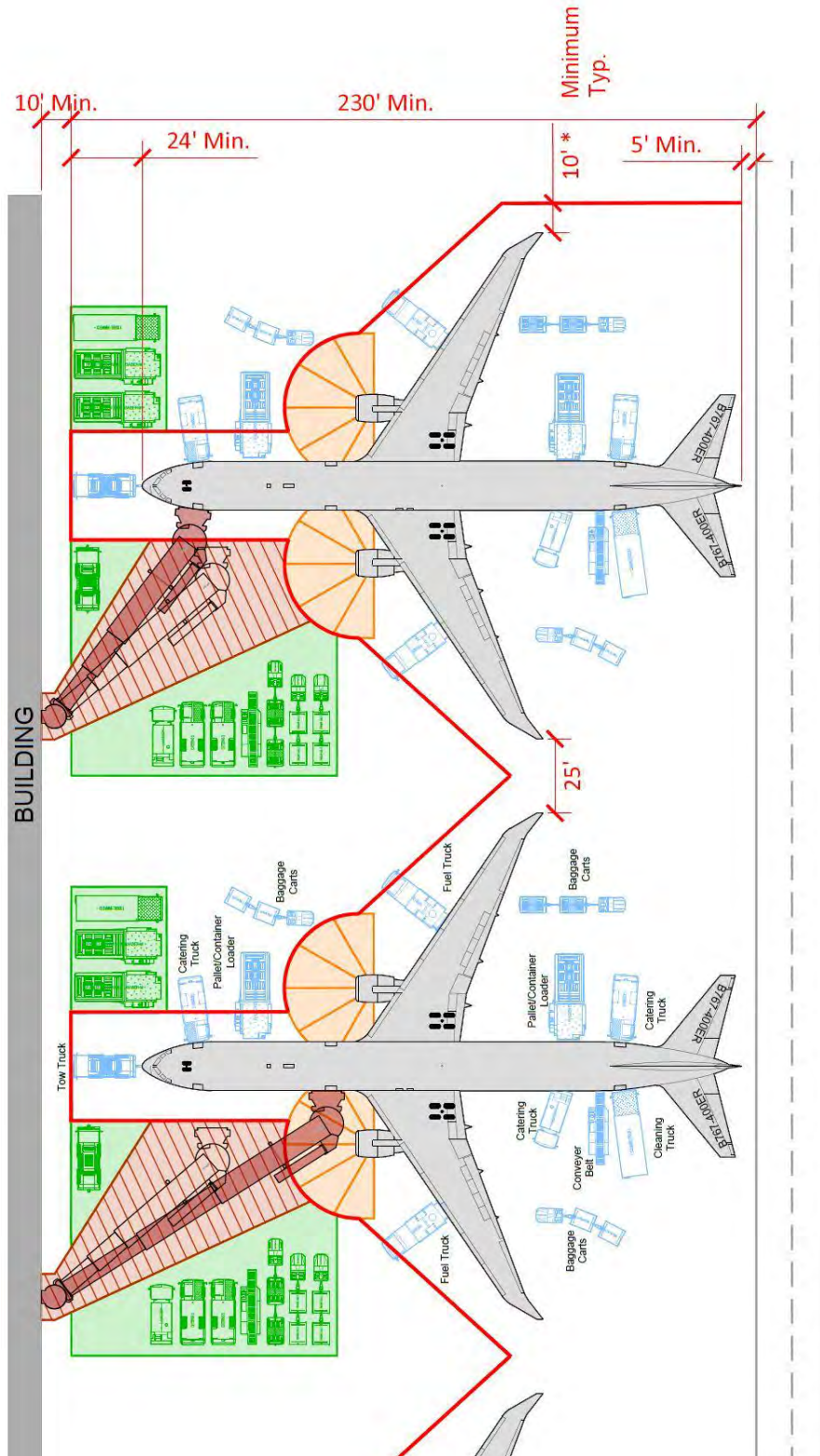


Figure 16: Typical Gate Layout for Group-IV Aircraft (without head-of-stand road)
 [The figure is given for illustration purposes only]

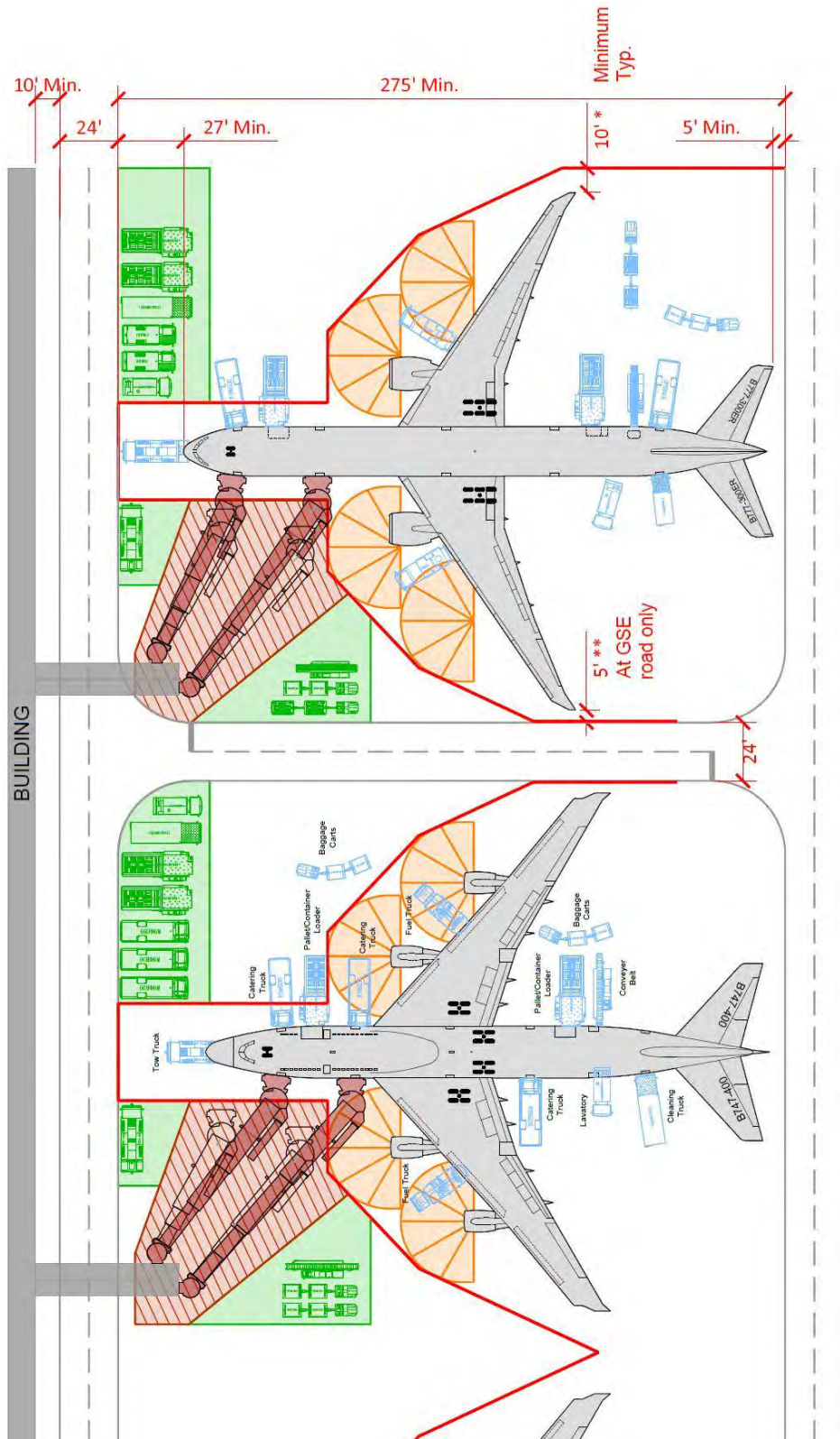


Figure 17: Typical Gate Layout for Group-V Aircraft (with head-of-stand road)
 [The figure is given for illustration purposes only]

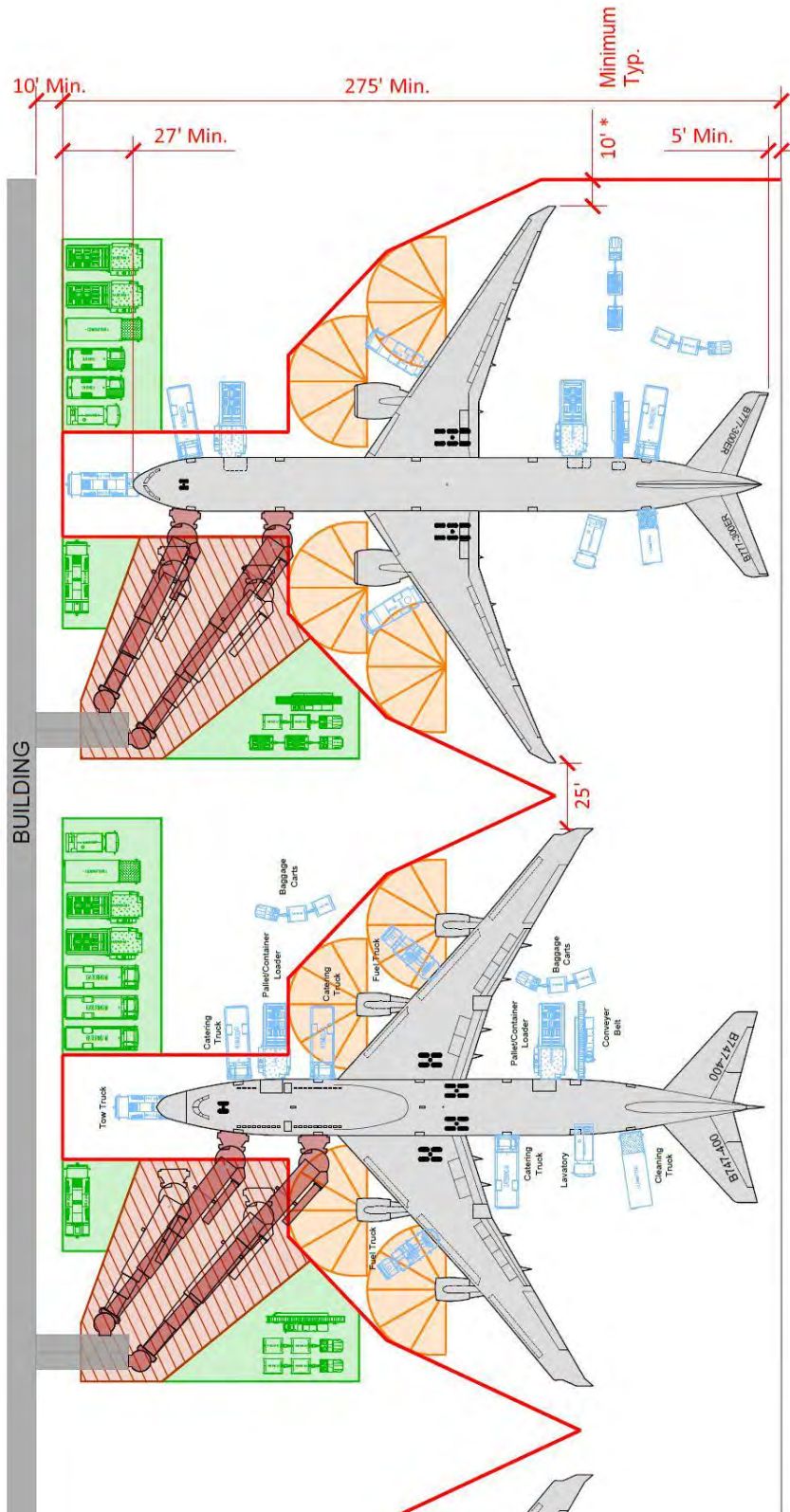


Figure 18: Typical Gate Layout for Group-V Aircraft (without head-of-stand road)
 [The figure is given for illustration purposes only]

d. Live Hardstand Positions

“Live Hardstands” are defined by the Port Authority as any airside parking position where an aircraft operator loads and/or unloads passengers, regardless of the type of flight (scheduled or unscheduled) and the size of the aircraft.

For planning purposes, the use of live hardstands on a permanent basis is prohibited at the Port Authority airports. Any proposed plan considering the use of live hardstand operations must demonstrate the temporary need for them, by assessing all alternative options and justify that none of them meet the program’s objectives and requirements. Any plan for live hardstand operations must be submitted to the Port Authority for review and approval in the early planning stages of the project.

While all the geometric design criteria presented in this section must be met for live hardstand positions, the following additional requirements need to be considered for the temporary use of live hardstands:

- Aircraft engine must not be in use when passengers are boarding or deboarding the aircraft
- Passengers walking on the apron must be escorted at all times for security purposes
- For passengers walking on the apron, jetblast protection shall be provided from other aircraft operating in the vicinity
- Additional requirements may be prescribed by the Port Authority for night and winter season operations on a per-project basis.

3. Taxilane Layout Requirements (Dual-Taxilane)

As a general guidance, all proposed new apron or apron expansion should provide dual taxilanes for the critical aircraft in order to allow for simultaneous push-back of adjacent aircraft and by-pass ability for arriving aircraft during departing aircraft pushback.

The Port Authority does not recommend the use of single taxilanes on aprons that serve more than eight contact gates.

Where the implementation of dual taxilanes is not feasible, the proponent must consult with Port Authority Aviation Planning Division for review of the proposed alternatives.

4. Gate Equipment



Figure 19: Passenger Boarding Bridges

- a. Passenger Boarding Bridges (PBB) and Fixed Walkways:
 1. PBBs should be positioned to maintain maximum flexibility to accommodate as many aircraft types as possible (in alignment with the mix of aircraft). PBBs should also be sited and specified so that the slope of the bridge is not greater than 1:12 for the gate's mix of aircraft.⁸
 2. PBB and Fixed Bridge Analysis must be incorporated as part of any proposed plan. The following information shall be depicted in the Aircraft Layout Plan drawing set for each gate (existing and proposed):
 - i. PBB Equipment Manufacturer and Model
 - ii. Operational ranges
 - iii. Rotunda heights
 - iv. Summary of aircraft to be serviced at each gate with PBB lengths and actual slopes realized for each aircraft type.
 - v. PBB-mounted equipment serving the parked aircraft such as preconditioned air (PCA), ground power, and potable water

⁸ FAA AC 150/5360-13A

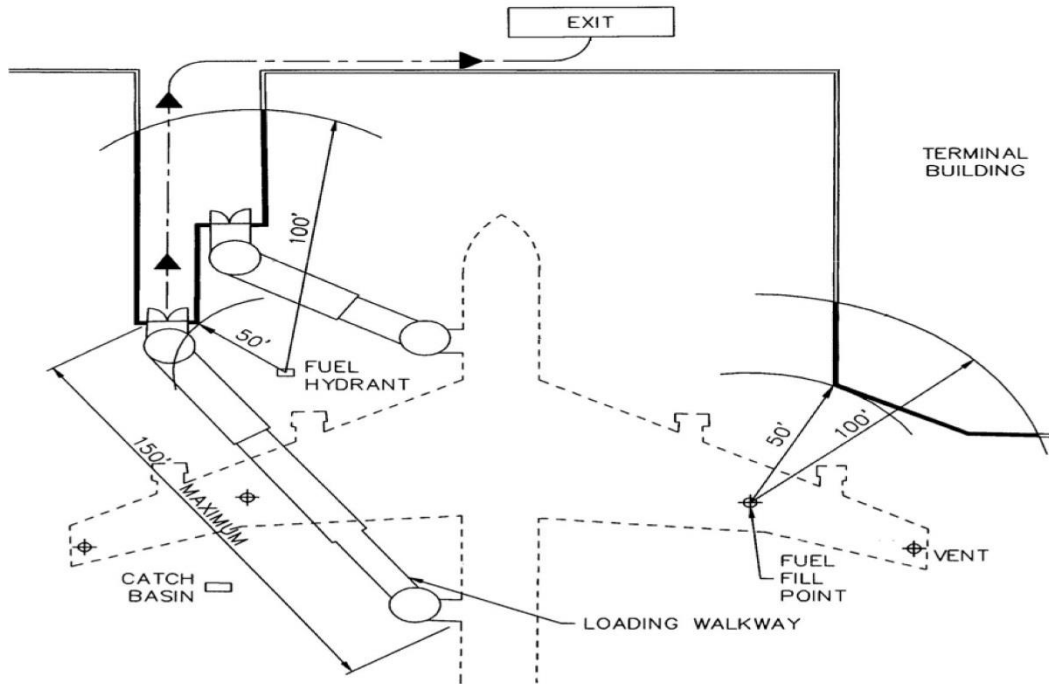


Figure 20: Airport Rampside Clearances

3. For new facilities the PBBs shall be designed and proven capable of servicing all specified aircraft without the use of manually-placed, doorsill transition ramps.
4. The PBB shall be capable of negotiating doors, stairs, fuselage diameters, Pitot tubes, TAT sensors, AOA probes, antennas, etc. for all specified aircraft, in a safe and commercially acceptable manner without the use or aid of a separate ramp.
5. Gates that are to be used by ADG-V aircraft for over 40% of daily operations as shown by the design day flight schedule (DDFS), shall have two passenger boarding bridges installed. Gates servicing high density ADG-VI aircraft shall have three passenger boarding bridges installed.
6. Port Authority requires that gate signs are mounted on each PBB included in the proposed plan.
7. The positive pressure ventilation fan shall be of sufficient capacity to provide and maintain a positive pressure throughout the bridge and shall be automatically activated anytime that an aircraft is at the bridge.
8. PBB design must be compliant with NFPA requirements and should be submitted to Port Authority for review and approval.
9. The design shall provide a safe exit route from the aircraft for a period of at least five (5) minutes under severe fire exposure conditions, equivalent to a free-burning jet fuel spill fire, in compliance with NFPA 415. The Engineer-of-record shall certify compliance in writing and submit the test reports and computations as defined in NFPA 415 to demonstrate compliance.
10. Loading Walkways shall be designed to prevent sudden failure (collapse, explosion, or development of excessive smoke and gases) during the ten (10) minute test.

11. Walkways shall comply with the following:

- i. A maximum combined travel length of passenger boarding bridge and fixed walkway shall not exceed 150 feet. Portions of fixed walkway exceeding 150 feet shall be designed as part of the terminal building.
- ii. A minimum width of 44 inches or the width of the aircraft door being served, whichever is larger.
- iii. Non-slip floor covering
- iv. Emergency lighting.
- v. Light diffusers of plastic material shall be of an approved type for exits, or wired glass shall be used.

12. Compliance shall include:

- i. Structural integrity of the walkway under the fire conditions.
- ii. Integrity of flexible closures, slat curtains, and miscellaneous seals with weather-stripping curtain with respect to smoke penetration through cracks and openings shall be established.
- iii. Particular attention must be paid to the following details:
 - There shall be no direct path for flame or smoke between the exterior and the interior of the bridge.
 - The junctures of bridge components, such as hinge pins and slat curtains, shall be covered or sealed with appropriate fire-resistant material.
- iv. The positive pressure ventilation fan shall be of sufficient capacity to provide and maintain a positive pressure throughout the bridge and shall be automatically activated anytime that an aircraft is at the bridge.

13. The door opening into the walkway shall have an electrical interlock to prevent opening until the passenger boarding bridge is engaged with the aircraft.

14. The aircraft loading walkway shall not be located over any drainage outlets. See NFPA 415.

15. The electrical installation shall comply with the applicable requirements of the National Electrical Code, particularly with the Hazard requirements; i.e., presence of flammable vapors from aircraft fueling, venting, and storage points.

16. For fixed walkways, minimum height cannot be lower than 7 feet 6 inches.

b. Ground Power

1. Ground Power must be provided at each gate with capability to service the existing and forecast fleet mix.

c. Preconditioned Air (PCA)

1. Preconditioned Air (PCA) must be provided at each gate with capability to service the existing and forecast fleet mix.

- d. Potable Water Cabinets (PWC)
 - 1. Potable Water Cabinets (PWC) must be must be provided at each gate with capability to service the existing and forecast fleet mix.
- e. Visual Docking Guidance Systems (VDGS)
 - 1. Automated VDGS must be provided for each lead-in line
 - 2. A summary of the type and utility requirements for each VGDS must be included as part of the proposed plan.
- f. Ramp Information Display System (RIDS)
 - 1. Automated VDGS must be provided for each lead-in line
 - 2. The VDGS system must include ramp information within the display unit (RIDS). The RIDS can be integrated with the terminal gate operating system as needed.
 - 3. A summary of the type and utility requirements for each VGDS must be included as part of the proposed plan.
- g. Emergency Egress Zone
 - 1. Emergency egress zones must be provided at the terminal façade to permit adequate clearance for terminal egress.
- h. Ground Service Equipment Considerations (GSE)
 - 1. Proposed plans must demonstrate that that there is adequate apron space to support typical Ground Servicing Equipment (GSE) storage and staging. At the project planning stage, the following information must be provided to the Port Authority for review and approval:
 - i. Program requirements for GSE support and maintenance, including a detailed list of equipment;
 - ii. Dedicated areas for parking:
 - 1. Staging/parking areas for day-to-day operations
 - 2. Parking of seasonal equipment
 - 2. Note: Port Authority may require vehicle maneuvering plans for some areas of concern.
- i. Apron Striping
 - 1. Apron striping for all gates must be provided to the Port Authority for review and approval:
 - i. Lead-in lines: proposed aircraft layout plans should aim at providing one lead-in line at each gate;
 - ii. Stop bars: proposed aircraft layout plans should aim at minimizing the number of stop bars required at each gate.

5. Aviation Services

a. Planning and Design

To mitigate inherent risk to passengers, refueling is normally performed on the side opposite passenger loading, i.e., the right side of the aircraft. However, this may vary depending on where the refueling points are located on the aircraft.

b. Regulatory Issues

Aircraft refueling facilities and ramps must be designed in accordance with National Fire Protection Association (NFPA) 407, *Standard for Aircraft Fuel Servicing*, and NFPA 415, *Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways*. Specific planning and design related guidance from these documents is as follows:

1. If possible, potential fuel spill points (pfsp) should be designed to be at least 100 feet away from the terminal or other buildings walls. When this is not possible, the use of glass or other glazing materials in the terminal or other buildings walls facing the apron should be avoided.
2. Large areas of window glass, covering more than 50% of a wall and located at a distance of less than 100 feet from a potential fuel spill point (pfsp), shall be protected by an automatic water curtain system or fire shutters activated by an appropriate fire detection system. In determining the previous percentages, only that portion of the wall not backed by the building's structural components should be included. The distances from the pfsp shall be measured horizontally to the center of the wall. This provision does not apply if openings covered with glazing material are listed for use in fire barrier and are installed in accordance with listing, or if the openings have the glazing material not less than 7 feet above each finished floor level.⁹
3. There shall be no pfsp such as fueling hydrants, catch basins, fuel tank fill connections, etc., within 50 feet of the building.¹⁰

The 100 foot rule against non-protected glazing was put in place because, although a fuel-spill fire may not reach the building, the intense radiant heat from a large jet fuel fire can cause the glass surface facing the fire to heat up several hundred degrees, while the interior surface remains cool, causing great internal stresses within the glass which cause it to shatter, leaving the interior of the building exposed to the intense radiant heat.

Potential fuel spill points considered for the 100 foot rule includes any of the following:

- Aircraft refueling points and fuel venting points, whether or not they are on the side routinely used for refueling
- Underground refueling system hydrants (also known as "fuel pits")
- Refueling bowsers

⁹ NFPA 415, 4.1.5.1 - 4.1.5.3

¹⁰ NFPA 415, C1

- Apron drainage structures including catch basins and trench drains
 - c. Hydrant Fueling

Hydrant fuel system is an underground utility that is connected to a fuel farm. Under this concept fuel pits are installed at each aircraft position allowing smaller fueling vehicles to connect the fueling system to aircraft fuel intake points. A hydrant system fueling concept should be developed for any proposed airside development and should be submitted to the Port Authority for review and approval. Proposed concepts should identify areas where hydrant fueling systems will connect to the Port Authority system.

Proponents should provide fuel capacity requirements to the Port Authority based on the project specifications.



Figure 21: Hydrant Aircraft Fueling Operation¹¹

d. Bowser Fueling

This section covers planning and design guidance associated with aircraft refueling via tanker trucks, also known as “bowsers.” Bowsers are used if an underground hydrant system is not possible to provide, or is present but not functioning.

When refueling via bowsers, the positioning of the bowser should be based on the aircraft type.

¹¹ Refuel International



Figure 22: Bowser Fueling Operation

For B757, FAA Airplane Design Group III (ADG-III), and smaller aircraft, the truck should be positioned at the wingtip of the aircraft, at the edge of the wingtip clearance zone, also known as stand safety envelope. The stand should be configured so that this refueling position does not interfere with other aircraft servicing operations. The safety envelope should account for the refueling operations, because the refueling truck is considered an obstacle for the adjacent stand. The bowser should be parked facing away from the terminal, to allow for fast evacuation in case of an emergency; this is especially critical if a head-of-stand (HOS) apron service road is not available, and the bowser would be forced to make a multi-point turn or reverse away from the stand quickly.

When refueling widebody aircraft, the bowser can be positioned in front of the aircraft wing. As with smaller aircraft, the bowser should always be parked facing away from the terminal in order to be able to make a quick evacuation in case of emergency.

e. GSE Fueling/Charging

1. Proposed plan should indicate location for GSE fueling and charging.
2. Proponent should indicate share of electric-powered GSE.

f. Aircraft Deicing and Glycol Recovery

1. The proposed airside design must indicate the areas on the apron designated as deicing areas.
2. For each deicing designated area, the glycol collection system must be depicted and the specifications documented. In addition, calculation for peak hour demand during typical and heavy deicing events must be provided for Port Authority review and approval.
3. Glycol storage and dispensing plans must be provided.

g. Snow Melters Discharge

1. Strategy for snow melting, including list of equipment must be provided to Port Authority.

2. Snow storage area locations need to be identified in the proposed plans. The snow melting equipment should be connected to storm drainage.
3. A dedicated interface to storm drainage utilities for discharge must be provided.
4. Discharge from portable snow melters must be done via a designated chamber, or series of chambers within the storm water drainage system, which are to be specifically designed to accommodate the discharge.
5. The calculation of acreage and equipment capacity required must be submitted to the Port Authority for review and approval.

h. Triturator Facilities

1. Triturator facilities must be designed to provide disposal from aircraft bulk tanks into the sanitary sewer system.
2. The proposed facility must be fully enclosed in order to prevent undesirable odors and should be strategically located for access by toilet service vehicles.



Figure 23: Aircraft Ground Handling

6. Aircraft Jetblast Considerations

The effects of extreme heat and air velocities from aircraft jet and propeller engines must be considered when planning apron areas and adjacent service roads and buildings. Velocities greater than 30 mph can pose a threat to personnel, airport equipment, and facilities, as well as airfield pavement and erosion of unprotected soil along the edge of pavements. In addition, high velocities can cause sand, gravel, or other loose objects to become projectiles and be thrown for great distances or drawn into engines. Such flying objects can injure personnel and damage equipment, facilities and other aircraft. This chapter details the design considerations that need to be undertaken to minimize the effects of jet blast.

a. Design Thrust Levels

Most the areas adjacent to aircraft movement areas will be subject to jet blast of some level. There are three types of engine thrust that are commonly used to assess the critical velocities for use in building, apron, and taxiway/runway design.

1. Idle thrust

Nearly all facilities adjacent to aircraft movement areas will be subjected to idle thrust. Idle thrust is used when the aircraft is idling, or taxiing at constant, low speed.

2. Breakaway thrust

Breakaway thrust is the level of thrust needed to overcome inertia and initiate aircraft taxi movement. For most jet engines, it is generally 30-40% of maximum continuous thrust, depending on aircraft weight and taxiway gradient. Areas typically designed for breakaway thrust may include terminal buildings, apron and taxiway shoulders, holding bays and all pavements except for the runways.

3. Take-off thrust

Aircraft use 80-100% of maximum continuous thrust during take-off, and thus the runway pavement, shoulders and ends (blast pads) would be designed for this thrust level.

Aircraft manufacturers provide information on the exhaust velocities and temperatures for the three engine thrust settings described above, including horizontal and vertical jet blast velocity contours. This information is used when designing for jet blast mitigation measures.

b. Blast Fences

Blast fences are the most effective measure against jet blast effects. Blast fences are used to reduce or eliminate the detrimental effects of blast by deflecting the high air velocities, heat and noise associated with jet blast. Blast fences must be considered when it is impractical to provide a safe reasonable separation between aircraft engines and people, buildings or other objects on the airport. In addition, blast fences must be considered near runway ends, etc., to protect on and off-airport pedestrian and vehicular traffic from jet blast.

To determine where blast fences should be located all the possible aircraft movement patterns must be established. Each segment of the aircraft movement area, including the aprons, taxiways, holding bays and runways must be analyzed to determine the magnitude and all possible orientations for blast in that particular location.

Factors such as the location, purpose, aircraft fleet, height, etc. will influence the selection of the design of the blast fence.

The need and location of blast fences in the apron areas must be determined based on the movement pattern of the aircraft taxiing, entering or exiting aircraft stands, or aircraft parking area, when using their own power. Additional attention must be given to stands where passengers walk the apron to board the aircraft, because passengers are not trained to expect jet blast.

c. Other Types of Jet Blast Protection

Blast fences are the most effective means of jet blast protection. However, jet blast protection can be achieved by using other methods and materials. Natural or manmade obstructions located between the jet blast source and the area to be protected affords some level of protection. In areas where jet blast cannot be mitigated by a physical fence, other measures such as operational restrictions must be submitted to the Port Authority for review and approval.

d. Apron and Hardstand Considerations

When designing apron, taxilane, and taxiway areas, the design aircraft's blast contours provided by the aircraft or engine manufacturer must be analyzed to determine the jet blast impact to adjacent areas. Aprons and hardstands design must consider breakaway thrust even when only idle thrust is expected, because an aircraft may be required to stop taxiing unexpectedly at any location, and must be able to re-start taxiing using breakaway thrust; this includes aircraft taxiing into a gate. A safety review must be performed on turbojet aircraft departing their gate performing a powered turning maneuver onto the taxiway/taxilane (known as "power-out" from a gate). Additional jet blast hazards may be created when an aircraft executes a turning maneuver of 45 degrees or more from the gate/hardstand¹².

e. Velocity Exposure Rates

In general, maximum allowable jet blast velocities should not exceed the intensities listed below. Designers should review these, along with the velocities listed in FAA AC 150/5300/13A, Appendix 3, section A3-6(c) "Velocity Exposure Rates", and apply the more stringent requirement.

1. Recommended 20 mph, for all areas where members of the general public may be present, including passengers boarding aircraft at hardstands.
2. 35 mph, for apron areas where persons who are trained in air operations area (AOA) safety precautions, including the expectation of occasional exposure to jet blast are present.
3. 50 mph, for apron areas where no persons would be present in the open, but persons may be within enclosed vehicles.

For all areas with jet blast impacts, mitigation measures should be proposed as part of the development plan and shall be submitted for reviewed and approval by the Port Authority.

Appropriate mitigation measures include jet blast deflection fences, as described in FAA AC 150/5300-13A or ICAO Doc. 9157, Aerodrome Design Manual, Part 2 and special operational procedures.

7. Airside Pavement and Grading

a. Apron Grading:

1. Apron grading must be in accordance with FAA AC 150/5300-13A "Airport Design" and NFPA 415 "Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways."
2. Consideration for collection of runoff and drainage from must be included in proposed plans.
3. Proposed plans must indicate limits of apron pavement and the different pavement types between the proposed terminal building and the outer edge of the TOS roadway. Isolated "low-points" at catch basins or trench drains should be located outside of the parking area.

¹² NASA/Aviation Safety Reporting System [ASRS] Directline Issue No. 6, August 1993, Ground Jet Blast Hazard

b. Apron Paving

1. A pavement condition evaluation as well as of a future needs assessment must be performed based on the mix of aircraft using each pavement area.
2. The type of pavement used for each airside element (e.g., taxilane, TOS roadway) must be indicated.

c. Apron Slopes

1. Aircraft apron slopes should not exceed 1%. Fueling aprons shall slope away from the terminal with a minimum slope of 1% for the first 50 ft. Beyond the distance of 50 feet, a slope of 0.5% is permitted.
2. Transverse slopes across aprons should not exceed 1:200

8. Apron Floodlighting

Floodlighting is provided at aircraft parking and servicing areas (aprons) adjacent to the terminal (gates), and away from the terminal (remote stands, cargo stands, etc.) to assist the pilots in taxiing the aircraft into and out of the final parking position; provide suitable lighting for passengers to embark and disembark; provide the personnel performing aircraft servicing work with a safe and workable level of illumination to move about, perform their tasks, and discern objects and hazards; and ensure airport security.

a. Reference Documents

- *FAA AC 150/5300-13A - Airport Design*
- Illuminating Engineering Society of North America (IESNA) Recommended Practice (RP) 37-15, *Outdoor Lighting for Airport Environments*
- *ICAO Aerodrome Design Manual (Doc 9157), Part 4*

b. Planning and Design Approach

A strategy for apron floodlighting and calculations must be provided to show that the proposal meets the requirements. Criteria that will be used to design apron floodlighting must be indicated in proposed plans.

Primary consideration must be given to the newest types of LED apron floodlights, which are energy efficient, have good color rendition, and can be more precisely focused.

During design work consideration must be given to the physical characteristics of the site, including:

- The movement and the physical characteristics of the aircraft to be served
- The maneuvering, staging, and location of ground service equipment
- Apron service roads
- Underground utilities
- The dimensional relationships of parked aircraft to terminal building
- The safety, security, and operational practices related to apron control

The apron must be lighted uniformly, and the illumination levels must comply with the IESNA RP-37-15 "*Outdoor Lighting for Airport Environments*" recommendations. Floodlighting calculations must be submitted to the Port Authority for review and approval. The following criteria must be adhered to:

1. Floodlighting must be adequate for personnel performing various tasks at aprons including baggage and catering loading and unloading, mechanical checks and pre-flight inspections, fueling operations, etc. Supplemental lighting must be provided for tasks that require high color rendering index (CRI) light source, where workers need to see and distinguish colors clearly.
2. Night-time illumination levels at aircraft apron must be a minimum of 2 foot-candles (~22 lux), with an average-to-minimum uniformity ratio of 4:1 maximum.
3. The design must consider the dimensions of various aircraft types using the apron stands.
4. The light angle and shielding of glare must be considered to assure there is not impact on aircraft landing, takeoff, or taxiing operations.
5. To minimize direct and indirect glare, mounting heights for floodlights must be at least two times the maximum eye level of the cockpit of aircraft regularly using the airport.
6. Spill light from the aircraft stand must be limited to 5% of the average illumination in the aircraft parked position measured vertically at 6 feet above the ground at either the farthest edge of the apron service road behind the aircraft, or 49 feet from the tail of the aircraft if no apron service road is present.
7. The location of the floodlights must take into consideration the dimensions of the apron and the arrangement of aircraft stands.
8. All floodlighting on the apron must be placed at a level that is adequately adjusted and shielded to prevent interference with air traffic control and aircraft operations, without reducing necessary illumination of critical areas, as required by the FAA regulations.
9. The location and height of light masts must be placed to keep inconvenience to ground personnel due to glare at a minimum but to provide desired illumination levels.
10. High mast poles or towers used for supporting high output floodlights must be located between the individual aircraft parking stands, with light being directed to both sides. It is preferred that poles are equally spaced to achieve the most desirable uniformity.
11. Light distribution must be such that all colors used for aircraft markings can be correctly identified.
12. Adequate exterior lighting must be provided to allow the jet bridge operator to safely maneuver the bridge into position to dock to the aircraft. All limits of boarding bridge movement must be considered when locating light poles.
13. Light must be projected to each aircraft stand from at least two or more directions to decrease shadows.

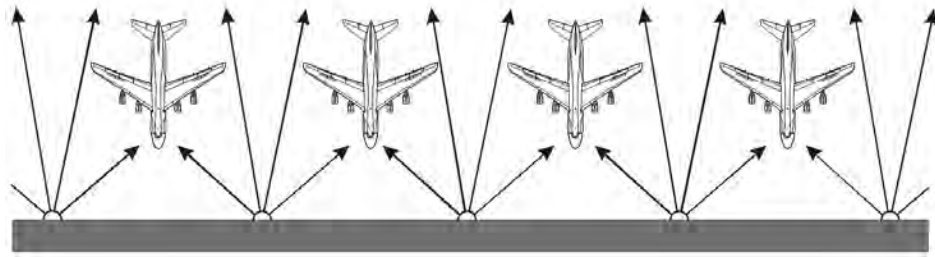


Figure 24: Typical floodlight arrangement and aiming for nose-in parking¹³.

14. Supplemental lighting must be provided for tasks that take place in areas where shadows cannot be avoided, such as under-the-body pre-flight inspections.
15. Emergency backup power supply must be provided for apron floodlighting. Emergency backup power must be designed to engage automatically in case of a main power failure.
16. When designing light poles, maintenance and accessibility must be taken into consideration.

c. Designated Deicing Facilities Floodlighting

1. Night-time illumination levels must be a minimum of 5 foot-candles (50 lux).
2. Adequate lighting for visual inspection of all the aircraft surfaces for ice must be provided.
3. Considerable vapor clouds can be generated when deicing fluid is sprayed on, which reduces the visibility in the designated deicing facility area. Designers must take this into account.
4. Floodlighting structures at designated deicing facilities must not generate distracting glare light that affects pilots or air traffic controllers.
5. FAA review and approval is required for deicing facilities located in close proximity to runways, where floodlighting could be distracting or confusing to pilots.

9. Aircraft Engine Startup Positions

- a. All aircraft engine startup positions must be identified on the proposed terminal area taxilanes. All startup procedures must remain within the non-movement area and should not impact the movement area.
- b. All startup positions must operate independently of each other.
- c. Restrictions to specific aircraft types must be documented (e.g., due to jetblast effects)

¹³ ICAO Aerodrome Design Manual (Doc 9157), Part 4

10. Restricted Service Roads

This section describes restricted service roads (RSR), which are generally designated via striping across the paved airside elements including aprons, taxilanes, taxiways, and other movement and non-movement areas.

The PANYNJ has established two distinct types of RSR:

- Airport wide access roads, which accommodate all types of vehicles including large trucks, which are comprised of two lanes 15 feet each (30 feet total).
- Apron service roads, which primarily accommodate aircraft servicing vehicles, which are comprised of two lanes 12 feet each (24 feet total).

“Zipper” dashed road markings must be used when any airside road crosses, or has a portion of a lane within, a taxiway or taxilane obstacle free area (OFA). This is done to increase driver awareness of taxiing or maneuvering aircraft. For new developments use of “Zipper” roads should be minimized to the extent possible. When unavoidable proposed “Zipper” road installations will be reviewed by the Port Authority on a case by case basis.

The image below shows the two types of airside roads, including portions with zipper striping.

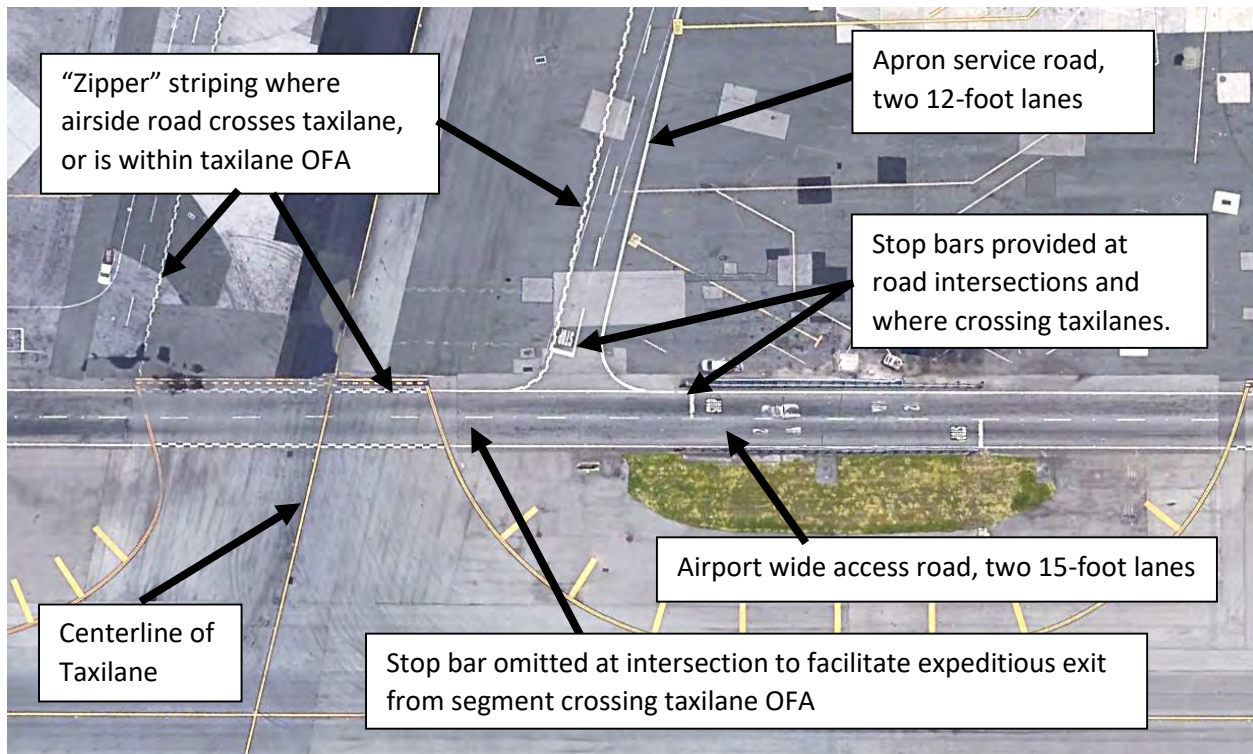


Figure 25: RSR image from JFK Airport

a. Planning and Design Criteria

1. RSR horizontal and vertical geometry must meet the Port Authority’s Civil Engineering Design Guidelines. The design speed for common access roads is 25 mph.

2. The design vehicle to be airport specific and determined by the Port Authority.
3. Sight distances for each of the roadway speeds must meet the standards of Section 3.2.1 AASHTO: A Policy on Geometric Design of Highway and Streets.
4. Curve widening must be applied over the length of the horizontal transition curve. The design widths for curve widening will be for both the super elevation runoff length as well as required sight distance per ASHTO: A Policy on Geometric Design of Highway and Streets.
5. “Stop” bars and “Stop” markings must be used at RSR intersections and when the RSR cross a taxilane or taxiway.

11. Airside Utilities

[Section under development]

12. Aircraft Deicing

Aircraft deicing is a critical operation for any airport in climate zones subject to freezing conditions. Deicing involves spraying an aircraft with a deicing fluid (usually glycol-based) that remains liquid at temperatures well below the freezing point of water so that liquid water and water ice are washed away/melted and replaced with deicing fluid on aircraft surfaces. This reduces the likelihood of ice altering airflow over the wing and tail, decreasing the lift force and potentially causing aerodynamic stall. It also reduces the likelihood that moving parts of the aircraft (e.g., ailerons, flaps) will become dangerously immobilized by ice. Deicing must be done relatively shortly before takeoff, especially in a heavy snowstorm, so that the deicing fluid does not run off or evaporate and get replaced by water, snow, or ice.

The deicing run-off will be captured and stored for discharged off-site for treatment or recycling. Deicing run-off discharge into the airport’s stormwater drainage system is not permitted.

Developers must submit a detailed deicing plan and concept of operations, including but not limited to: calculations of peak hour and peak day aircraft deicing demand; glycol storage facility plan with glycol demand/capacity calculations for both discharge (usage) and storage; and spent fluid collection, storage, facility plan and capacity calculation; and spent fluid discharge to off-site treatment.

a. Designated Deicing Facilities

It is Port Authority’s policy that aircraft deicing is to be done at designated deicing facilities. Designated deicing facilities should be established within project lease lines on aprons, taxilanes, or just outside the terminal gate area. They can be simple aprons with deicer-laden runoff collection capabilities or technologically advanced facilities with electronics that monitor everything from aircraft positioning to glycol concentrations in the runoff collection system. Planning considerations should minimize deicing at gates unless approved by the Port Authority.

b. Site Planning and Design

New terminal developments must include designated deicing facilities sized to handle proposed terminal demand. Site-specific issues such as available area, drainage and deicing fluid collection infrastructure, prevailing wind conditions, and jet blast should be considered when planning designated deicing facilities. Proximity to and queuing for take-off runways must also be considered. These should include

taxiing time that begins with the start of the last step of the deicing/anti-icing treatment and ends with takeoff clearance, such that the holdover times of applied fluids are still in effect.¹⁴

An ideally-planned designated deicing facility will have positions for multiple simultaneous deicing operations, allow aircraft to taxi-in / taxi-out in a one-way, flow-through setup. Provisions should be made for enough room for aircraft queueing and aircraft ability to bypass other aircraft parking positions to facilitate traffic movement and avoid back-ups.

c. Requirements Analysis

Departure rates at peak hours during winter events that require deicing should be used for determining the required capacity of the designated deicing facilities. The size of the designated deicing facilities should be determined considering fleet mix, peak demand, and queueing area. The location, queue, and size of the designated deicing facilities must be supported by capacity analysis and calculations. Capacity study must be submitted for Port Authority review and approval.

d. Facility Options

The optimum method for deicing application, using either fixed-boom deicing equipment or deicing trucks, should be considered. Glycol storage and dispensing calculations and plans must be provided. If a support building is desired, sufficient space should be allowed. A clear view of the deicing positions from the control room should be provided.

e. Deicing Fluid Collection and Treatment

Glycol breaks down naturally over time, however it is considered a pollutant that should be contained and not allowed into the general stormwater system. Designated deicing facilities must therefore be graded favorably for collecting and containing deicing runoff. Drainage designs that capture deicer-laden runoff and segregate it from “clean” runoff to minimize runoff volumes for treatment and disposal or recycling must be considered. Sufficient capacity for spent deicer-laden runoff storage under design storm conditions should be allowed. The drainage system of the designated deicing facilities must be independent from the airport stormwater drainage system. For each deicing designated area, the glycol collection system must be depicted and the specifications documented. Considerations should include wind dispersion and jet blast, grading, inlet locations, and underdrains. Glycol collection can be done via vacuum trucks or dedicated drainage system linked to storage tanks located on airport property. Sufficient storage must be provided for run-off deicer.

Multifunctionality of the site for year-round use, such as aircraft parking, etc., should be considered. Plans should be documented and submitted to PANYNJ for approval.

For designated deicing facilities floodlighting refer to *“Apron Floodlighting”* chapter.

¹⁴ AC 150/5300-14C, Design of Aircraft Deicing Facilities.

f. FAA Guidance and Port Authority Policy Requirements

1. Planning and designing dedicated deicing facilities should follow the planning and designing guidelines specified in the FAA Advisory Circular AC 150/5300-14C, “Design of Aircraft Deicing Facilities.”
2. Designated deicing facilities design must comply with PANYNJ Environmental Sustainability Policy.
3. Designated deicing facilities must meet the National Pollutant Discharge Elimination System (NPDES) permit requirements, such as sizing and siting the deicing facilities, designing aircraft deicing pads, aircraft access, collection capacity and recycling or disposal plan.

SECTION III: TERMINAL

Part 1 – Concept of Operation Parameters

The sections below describe the functional and qualitative characteristics of the various elements of airport terminals.

1. Passenger Check-in and Bag Check

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 a boarding pass. 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 passengers' identification documents and flight reservations and collect any outstanding fees.

Passenger preferences and recent trends and innovations in the check-in process must be considered and embedded in the design of terminal facilities. For example, IATA ADRM 10 indicates a shift in passenger preferences from using traditional check-in processes to the use of online check-in. 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 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.

a. Off-site check-in (multiple types)

Prior to the 9/11 Attacks, remote check-in and bag check was available at major travel and tourist destinations, including theme parks, convention centers, cruise ship terminals, and major Las Vegas casinos. After the 9/11 Attacks, TSA regulations required bag screening at the airport. With the advent of internet and smartphone technology, remote check-in (but not bag check) is now widely available for most passengers. Remote check-in with bag check may again be established at certain venues, if the security protocols and chain-of-custody of checked bags can be resolved.

Passenger acceptance and preference for 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.

Designers should refer to ACRP Report 25 which provides a summary of recent trends in the development and operation of these facilities. Designers should also check with newer trends, as these tend to reflect emerging technologies and will be subject to TSA regulations.

b. Curbside Counters

Most airports provide for curbside check-in. Allowing for curbside check-in can improve the Level of Service (LOS) for customers and increases the volume of passengers serviced without increasing the size of ticket lobbies. Typically, curbside check-ins are equipped with conveyor belts located at the check-in podiums for direct input of bags into the outbound baggage system. Airlines who do not wish to pay for conveyors may have checked bags placed on carts and taken into the check-in lobby to be transferred to the ATO counter bag conveyor¹⁵.



Figure 26: Departures / Check-in Hall

c. Departures / Check-in Hall

The departures hall is the “front door” of an airport terminal, where first impressions are made, and often receives special architectural treatment, high quality finishes, natural daylight, and high ceilings. The area should have good acoustical quality so that normal speech and paging system announcements can be heard. Airline kiosks and ticket counters should be arranged such that passengers can easily find and circulate to them. Ample circulation should be provided around the queuing areas so that passengers who do not need to stop at a kiosk, counter, or bag drop, can easily flow through to the security checkpoint.

A minimal provision of pre-security retail concessions, such as cafés and newsstands, should be provided for well-wishers, airport employees, and other members of the public who are not authorized to go post-security. Refer to Part 2, Section i for the minimal requirements for pre-security retail concessions.

¹⁵ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.2.1, 2010

d. Traditional Counters

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.

Even with the adoption of new technologies designed to put more of the check-in process with the passenger, a certain number of staffed traditional counters will always be required, to serve:

- Premium passengers who expect prompt, personal service
- Technology-averse passengers
- Unaccompanied minors
- Large, organized travel groups
- Passengers who were unable to complete their check-in and/or bag check transactions using smartphone, kiosk, bag drop, etc. due to technical glitches, failure to understand the technology, or other reasons
- Passengers with complex booking or re-booking transactions

1. Standard Counters

Standard counters have staffed airline personnel that check in and/or change flights for all passengers. It is meant for all passengers to use if other ticketing counter types are not available or if passengers prefer to be checked in through airline personnel rather than self-check alternatives. Refer to Part 2, Section 5 for traditional counter calculations.

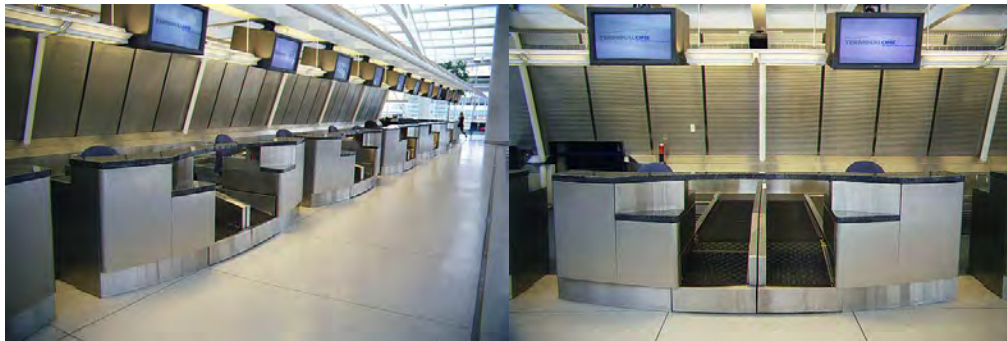


Figure 27: Typical Check-in Counters

2. Group Counters

Group check-in counters are oftentimes provided for airlines that have higher rates of group ticket processing. These counters are physically separated from standard counters and have their own queuing lanes and spaces as they may sometimes clutter the standard counters' queues. These are sometimes placed near baggage claim units as large groups may need higher space requirements to process. Refer to Part 2, Section 5 for traditional counter calculations.

3. Premium Counters

Airlines often provide a more personal service to their premium class passengers. These may include business class, frequent flyers or any other type of passenger requiring special attention. A dedicated

queue will be provided for them and many times the agents will serve premium passengers as soon as they arrive at the front of the queue. Additional counters will be made available to these passengers so that the maximum queuing time is kept to a minimum¹⁶.

Provisions for premium counters is largely an individual airline’s business decision. Different airlines may have different number of tiers for premium passengers. Some airlines have a highest VIP tier where passengers and their bags are checked in and check bags in a separate private room. Refer to Part 2, Section 5 for traditional counter calculations.

4. VIP Counters

The provision of counters for VIP passengers is often a requirement at major airports, especially at capital city airports where senior government delegations and people of importance travel through often. These VIP counters are often separated from the traditional counters to maintain the privacy of the person. It is up the airport officials’ and/or airlines’ decision to have separate private rooms for VIP passengers or alongside other traditional ticketing counters. Refer to Part 2, Section 5 for traditional counter calculations.

e. Self-Serve Kiosks

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 for greater deployment of self-service units within a given area and increases the number of positions where passengers can complete check-in transactions. Self-serve kiosks traditionally minimize the time that passengers spend waiting for an airline agent and reduce the overall check-in transaction processing times.



Figure 28: Self-Service Kiosks (Check-in Only)

1. Check-In Only

Certain kiosks are available for check-in only, with the capability to provide boarding passes, but not bag tags. These kiosks, dedicated to passengers with carry-on bags only, are clearly labeled “Check-in Only”

¹⁶ IATA ADRM 10th Edition, Section 3.4.11.6, 2017

or “No Bags to Check”, and are often located at the terminal front wall or a similar location, distant from the counters and/or bag drop induction points.

2. Baggage Check, Weighing, and Tag

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). Currently, airlines do not offer passengers the options for fully automated (self-service) baggage drop procedures, but this may occur in the future.

Because there are weight classifications and limits for each individually checked bag, scales should be provided where self-tagging is available so that passengers can weigh their bags. Open space, tables and countertops should be provided as passengers may need to repack their luggage in order to meet the weight limits and avoid paying additional fees.

f. Baggage Drop Induction Points

Conventional processing facilities can be operated simply as bag drop desks. In this case, only the bag weighing, tagging and bag induction process are carried out by the agent. This option provides convenient and quick processing for passengers, and minimizes agent transaction time. Passengers using these facilities will have completed their check-in by other means (i.e., online, mobile app or at a self-service kiosk at the airport). In this way, a time-consuming part of the process is removed from space-demanding facilities and provided via very space-efficient self-service kiosks or removed altogether from the terminal¹⁷.

Bag Drop points are locations where passengers bring checked bags that are tagged and ready for induction into the system. The passenger places their bags on an induction belt, which is a bag belt near floor level that only runs when activated by an agent. The induction belt has a built in scale, to provide a final confirmation that the bag is within weight limits. The agent verifies the passenger’s identity and boarding pass, then scans the bags, and pushes a button to induct the bags into the system. Currently in the US, TSA regulations require airline agents to positively ID each passenger when inducting their bags. In other countries, no agent is required, the passenger simply scans their boarding pass and bag tags, and the bags are automatically inducted when the appropriate credentials are confirmed by the system. The US may migrate to this protocol.

g. Restrooms

Refer to Part 1, Section 7.

2. Outbound Baggage Handling System (BHS)

The airport baggage handling system (BHS) generally consists of two separate systems: outbound and inbound. The outbound system is used by the airlines for check-in, delivery to the Transportation Security Administration (TSA) security screening facilities, acceptance from TSA screening, storage,

¹⁷ IATA ADRM 10th Edition, Section 3.4.11.3.4, 2017

sortation, and loading of checked baggage onto baggage carts for delivery to departing aircraft. Most of the outbound BHS facilities are located downstream of TSA screening and are used for all originating passenger baggage, and any connecting passenger baggage not otherwise delivered to the passengers as part of a Customs inspection or a non-interlined itinerary. All transfer baggage incoming from international flights not yet screened by the TSA and outgoing to subsequent connecting flights, is required to be screened by the TSA before being loaded onto the departing aircraft. Depending on the size of the terminal facility and volume of transfer traffic, transfer bags can either be processed by the same system or through a separate, dedicated system.

Baggage is introduced to the conveyance system at different check-in locations, such as traditional counters, baggage drops, and curbside check-in, and is then transported by conveyors to the TSA screening location. After screening, cleared bags are then transported to the outbound baggage makeup areas by conventional conveyors or conveyance vehicles, such as linear (or chain) drive sorters or destination-coded vehicles. Contemporary outbound baggage facilities use automated sortation systems to distribute bags between individual baggage makeup devices, where the baggage for each individual flight undergoes the “make-up” process where it is picked from the makeup devices and placed on carts to then be transferred and loaded onto the aircraft.

Older or smaller systems may lack automated sortation systems and centralized baggage screening systems and will essentially operate as point-to-point systems. Automated sortation systems are able to deliver bags from a common baggage screening facility to specific baggage makeup devices, which may be organized by airline; or, in the case of a large hub airline with multiple makeup devices, by flight. 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 following diagram from TSA’s Planning Guidelines and Design Standards for Checked Baggage Inspection Systems (PGDS), shows the process through the outbound BHS.

a. Take-Away & Collector Belts

Baggage is inducted into the BHS at different locations, such as the departures hall, curbside, and transfer offloads. Collector belts are used to consolidate flows from multiple induction points before conveying bags towards screening. Best practice for designing collector belts is that main line redundancy (e.g., cross-over belts) are provided to minimize loss of capacity during outages. Depending on the specific Checked Baggage Inspection System (CBIS) design, bags typically travel along the main line collector belts to the TSA screening zone. Optionally, bags can travel over several types of load-balancing devices prior to arriving at the screening zone¹⁸.

Pre-Explosive Detection System (EDS) main lines are conveyor lines where input lines are merged to create a main delivery conveyor line that delivers baggage for diversion to individual EDS lines. To provide redundancy in the system, designers should consider additional delivery conveyor lines such that a single point of failure will not cripple the entire system.

¹⁸TSA PGDS Version 5, Section 3.1.2, 2015

EDS lines are the conveyors that transport baggage from diversion off the main line to several individual EDS machines via queuing conveyors.

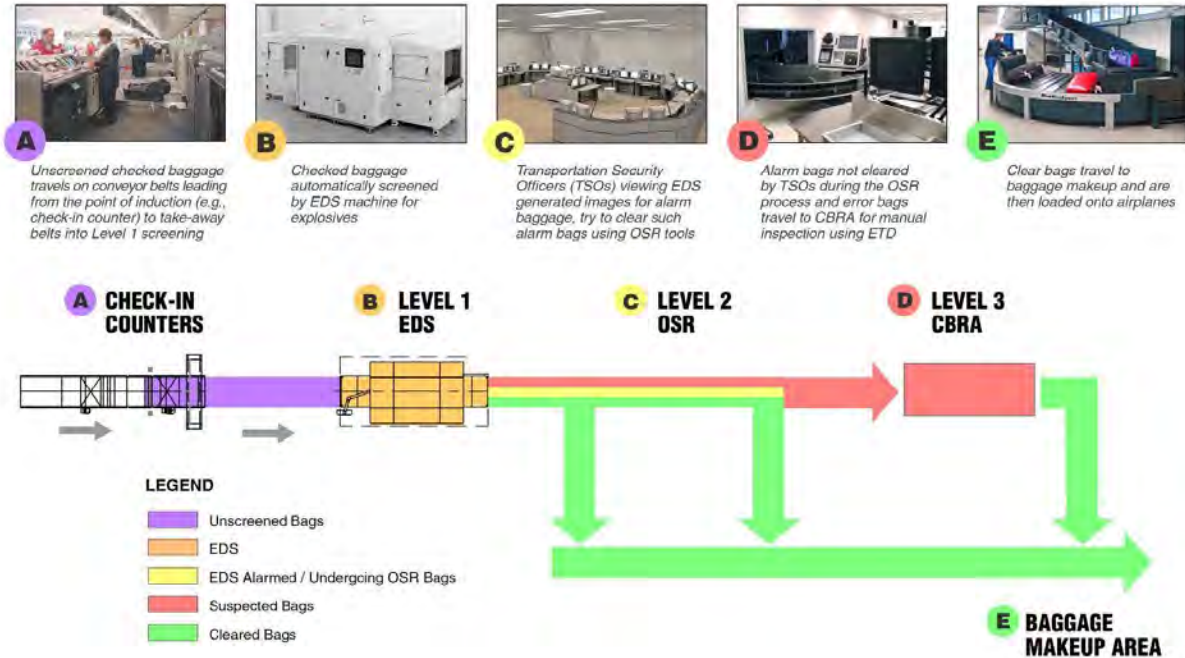


Figure 29: Schematic design of baggage induction sequence

b. Checked Baggage Inspection System (CBIS)

Unscreened bags are sent to EDS conveyor subsystems consisting of queue conveyors in front of each EDS. Various methods can be used to configure BHS control logic, which drives load balancing between or among EDS units¹⁹.

The Checked Baggage Inspection System (CBIS) process involves three screening levels²⁰:

- Level 1 screening is performed with EDS equipment. All bags that can physically fit in an EDS are directed to Level 1 screening and scanned using an EDS, which takes a 3D computed tomography (CT) image of the bag and its contents, and automatically alarms or clears the bag based on software detecting potential threat objects. Bags automatically cleared by the EDS typically exit and are transported through the first-chance cleared-bag divert point located at a relatively close location downstream from the EDS. All bags that automatically alarm at Level 1 are subject to Level 2 screening.
- During Level 2 screening, TSA personnel review 3D images of alarmed bags captured during the Level 1 EDS scan, focusing on alarmed objects in the bag, and then provide a Clear or Alarm designation to the bag. This process is referred to as On Screen Resolution (OSR) which allows the continuous flow of bags through the CBIS until a decision is made. All bags that cannot be

¹⁹TSA PGDS Version 5, Section 3.1.3, 2015

²⁰TSA PGDS Version 5, Section 3.1.3, 2015

resolved at Level 2 (e.g., Time Out Bag), and all bags that cannot be directed to Level 1 because of size restrictions, are sent to Level 3 screening.

- Level 3 screening is performed manually and involves opening the bag and the use of Explosives Trace Detection (ETD) technology. Bags that pass Level 3 screening are returned to the outbound BHS, while the very small percentage of bags that do not pass Level 3 screening go to Level 4 and are either resolved or disposed of per the current TSA checked baggage Standard Operating Procedure (SOP) which typically involves the local law enforcement officer.

c. Checked Baggage Resolution Area (CBRA)

Bags that are not cleared by OSR screening, unknown or system tracking error bags, and oversized bags, are diverted to the Checked Baggage Resolution Area (CBRA). When a bag arrives at the CBRA, its corresponding image, which is transmitted over the EDS network, is retrieved by the TSA screener using the bag identifier. Based on the bag image, the TSA screener identifies and locates the alarm object(s) within the non-clear bag and manually clears the object(s) using manual ETD inspection. If the bag image cannot be retrieved, the TSA screener must perform additional screening measures on the alarm bag per the current checked baggage SOP²¹.

- Bags clearing ETD screening are re-inserted onto a cleared bag conveyor and typically merged with the main flow of bags to the bag sortation or makeup area. A clear bag is any bag that has received a “Clear” security screening decision at Level 1, 2 or 3 security screening.
- Most non-clear bags (as well as unknown and oversized bags) at the CBRA are cleared using ETD.

d. Distribution Belts

Post-EDS main lines are the conveyor lines where all EDS clear lines, which includes Level 1, Level 2, and Level 3 cleared baggage, are merged for transport to the make-up area.

There are various types of sortation devices that divert bags from main lines to branch lines, including vertical sortation units (VSU), pushers, tilt-trays, Individual Carrier System (ICS) tippers, each with different capabilities.

Types of Baggage Sortation Systems. There are four types of baggage sortation systems²²:

- **Centralized sortation (localized to terminal):** A centralized sortation BHS gathers all input bags, originating and transfer, into one location and then sorts the bags to the flight’s designation. These systems usually employ automated tag readers (ATRs) for automated scanning and universal encoding consoles (UECs) for manual encoding if the automated scans fail. A single centralized sortation system, while offering flexibility, will however be at a disadvantage when trying to maintain operations during system modifications, expansions, or upgrades.
- **Decentralized sortation (localized to gates):** A decentralized baggage sortation system sorts the bags at two or more locations, or the actual flight sortation is performed at or near the individual airplane gates. These systems usually employ ATRs for automated scanning and UECs

²¹TSA PGDS Version 5, Section 3.1.5, 2015

²²ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 4.1.3, 2010

for manual sortation if the automated scans fail. Bags will need to be identified with an ATR when multiple make-up carousels are used.

- **Common-use sortation system:** A common-use sortation system incorporates all the carriers' bags into one common sortation and delivery system to process and sort the bags by carrier destination. A major benefit of this system is that any future additions, removals, or modifications are simplified because all inputs feed into one single sortation and delivery system. Another major benefit is that if carriers are operating with sporadic departure times, all carriers' schedules can be combined to maximize the use of the sortation system. A single sortation system will however be at a disadvantage when trying to maintain operations during system modifications, expansions, or upgrades.
- **Manual sortation:** A manual sortation system does not employ ATRs or UECs. The baggage sortation takes place in the baggage make-up area with airline personnel manually sorting each individual bag and placing it in the appropriate cart. In this arrangement, common make-up devices can be shared by multiple carriers if required. Bags will need to be identified with an ATR when multiple make-up carousels are used. This legacy type of system is more labor-intensive, and appropriate for smaller, low-volume airports. It would generally not be feasible at larger PANYNJ airports.

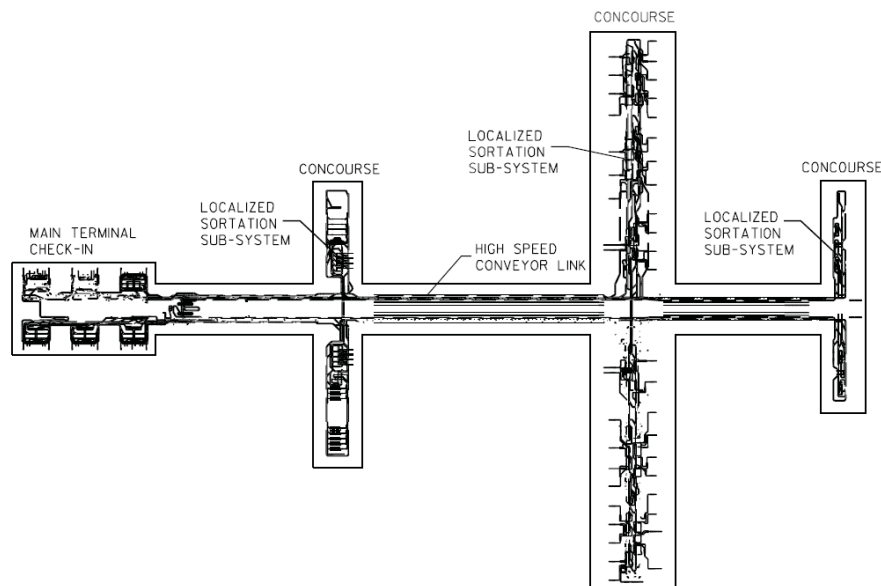


Figure 30: Decentralized sortation baggage handling system²³

²³ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design

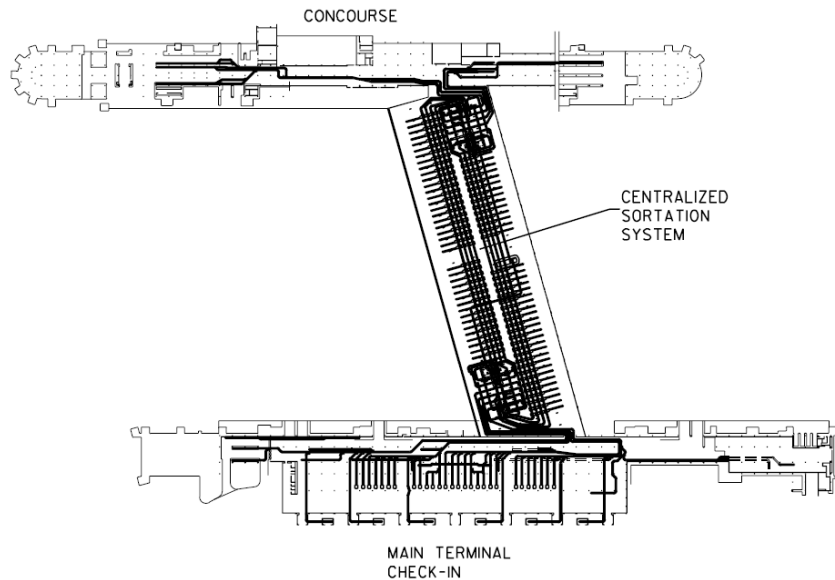


Figure 31: Centralized sortation baggage handling system²⁴

e. Early Bag Storage (EBS)

Early Bag Storage (EBS) is utilized in some facilities when a large volume of originating or transfer bags show up at the airport terminal much earlier than flight departure time, and the airlines do not have an economical method of handling or storing these bags within the outbound baggage system. Large volumes of passengers may show up early at the airport due to factors beyond their control, e.g., being part of a cruise or other organized tour. At busy airports without an EBS, passengers are typically not allowed to check bags more than three or four hours before scheduled time of departure, because the outbound BHS does not have buffer storage to accept the sheer volume of bags. The EBS is typically located near the outbound baggage system and will feed bags back into the BHS for sortation and delivery. It can be loaded by either (1) a dedicated transfer load belt for early transfer bags or (2) a diversion from the outbound sortation system for early originating bags. The bags stored in this facility usually have more than 120 minutes before departure²⁵.

f. Make-Up

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, as it has been brought out of the sterile area and had passenger contact. Outbound baggage makeup requirements define the amount of space needed to accommodate the types and number of baggage

²⁴ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 4.1.3

²⁵ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 4.1.3

makeup devices and operational, vehicular, and staff support areas required to support terminal activity.

1. Make-Up Devices

Make-up device types include circulating sloped-plate (“carousel”) and flat-plate (“racetrack”) units, straight-line conveyors with indexing operations (“laterals”), and fixed chutes fed by overhead tilt-tray conveyors – all of which have implications on handler operations. 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.



Figure 32: Sloped-Plate Bag Make-up Device²⁶

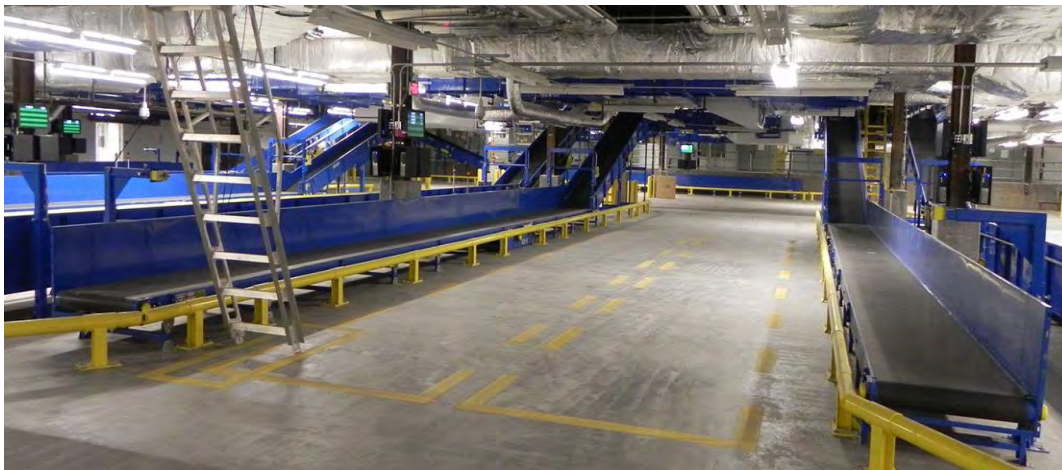


Figure 33: Straight-Line Bag Make-up Device²⁷

²⁶ Unified supply Co.

²⁷ Clark Construction Group

2. Make-Up Rooms

Make-up rooms are typically located at the apron level, but can also be below grade with ramped vehicle access. They can be fully enclosed or without side walls, depending on climate. In the New York / New Jersey area, due to cold winters, the rooms should be fully enclosed. In addition to the make-up devices, associated work areas, and vehicle circulation, these rooms may contain areas for additional carts (as a form of EBS), and other vehicle parking, which may include electric charging capabilities.

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

- Type of makeup device.
- Bag cart/tug staging and loading zones and circulation aisles and lanes.
- Control rooms and power cabinets. The BHS control room contains the essential components to monitor and operate the BHS properly and optimally. This room typically needs 400 square feet to accommodate the all the systems required. Verify with BHS designer.
- Miscellaneous spaces for staff, such as locker rooms, break rooms, and restrooms.
- Baggage handling system maintenance room: this type of room is required to maintain, build, or repair conveyor parts to assist with the proper upkeep of the BHS. Special consideration of size and location of the maintenance room/area is required depending on the complexity and magnitude of the BHS. The recommended size of this room would range between 300 and 800 square feet, including space for spare parts. Verify with BHS designer.

Figures below show different examples of circulation spaces between make-up carousels, including double side and single side piers.

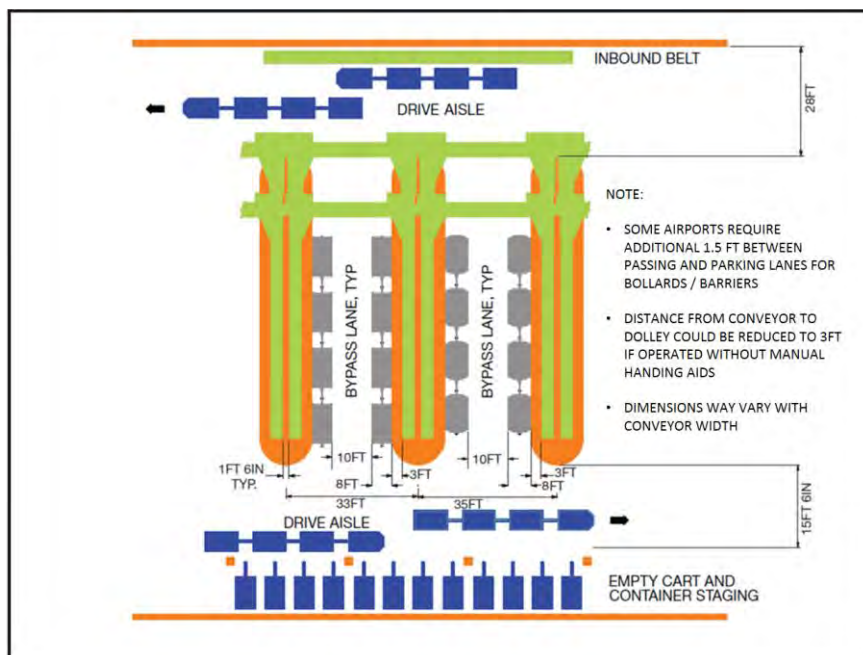


Figure 34: Space allocation for drive aisle/drive-through tug circulation²⁸

²⁸ Graphics from ACRP 25, dimensions from Arup

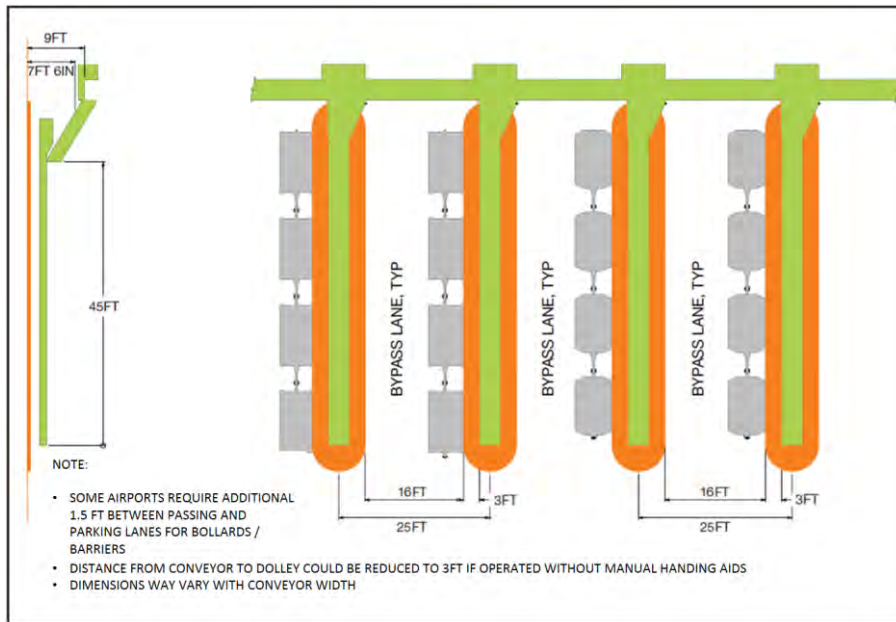


Figure 35: Sort pier spacing (single-sided piers with bypass lane, one mainline)²⁹

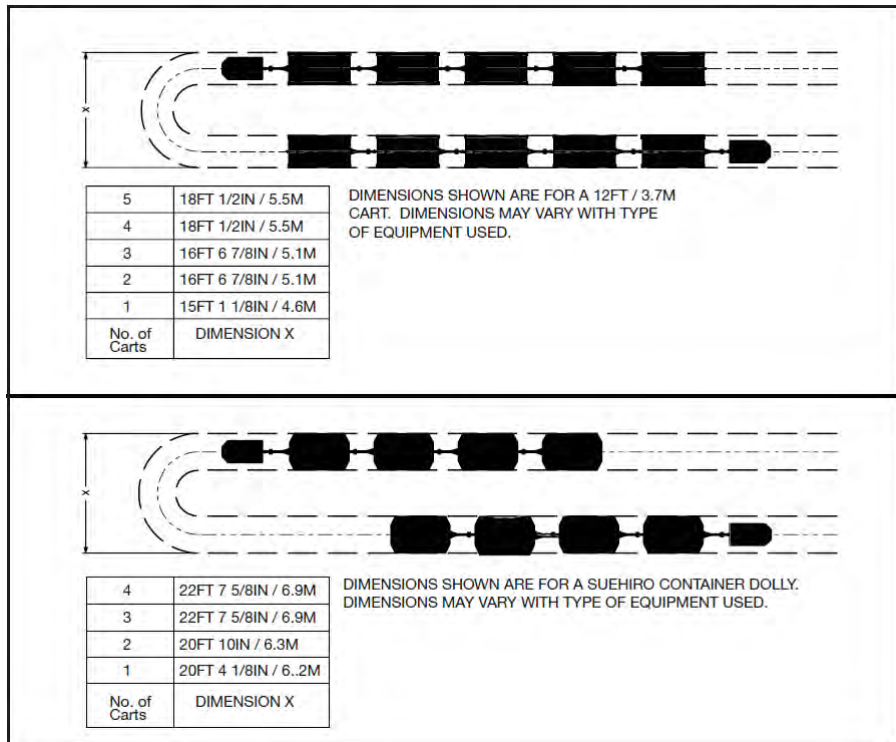


Figure 36: Turning radius for tug and cart³⁰

²⁹ Graphics from ACRP 25, dimensions from Arup

³⁰ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design

Although discussed separately in the Guidelines, offload areas for inbound (arriving) baggage are sometimes collocated with outbound baggage makeup areas.

g. Oversized Baggage

Out-of-gauge (OOG), also known as “out-of-spec” (OOS), or most commonly “oversize” (OS), baggage, is baggage and other checked items that are either too large, or of an irregular shape or lacking rigidity (such as sports gear, golf clubs, bikes, wheelchairs, medical equipment, garment bags, etc.) that would be likely to be mishandled and/or damaged by the automated BHS; are too large to fit on the conveyor belts or makeup units; or might cause jams in the system.

The terminal designer must provide special check-in desks or bag drop stations for oversize bags, which must be clearly marked as such. The number of oversize bag drop stations should be based on demand characteristics of the passengers typically using the facility. The oversize bag check should be provided with wider conveyor belt, having few or no turns along its length, to convey the oversized items to the TSA Level 3 screening. The BHS designer should specify the appropriate width, slope, and turning radii of the oversize bag conveyor belts. Alternatively, the oversize items may be manually transferred to the TSA; however, conveyors are preferred.

After TSA screening, provide a dedicated oversize belt system designed to handle conveyable pieces of luggage, and a manual delivery operational methodology for non-conveyable items like bikes, surfboards, etc., to the secured non-public side of the bag makeup room³¹³². For the transfer from TSA screening to makeup, it is again preferable to use conveyors to the extent practicable rather than manual delivery.

3. Passenger Security Screening Checkpoints (SSCP)

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.

The physical characteristics of a terminal, passenger characteristics, and even seasonal changes affect screening lane throughput. The TSA issued a Checkpoint Design Guide (CDG) is 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.

a. Travel Document Check (TDC)

Travel document check (TDC) staffed positions are required at the entrance to the SSCP lanes. The TSA officer reviews each passenger’s ID and boarding pass, and scans the boarding pass to verify they are checked in on an upcoming flight. The required number and configuration of TDC positions should be based on their processing speed as well as the configuration of the general queues and SSCP lanes. TDCs are located at the end of the general SSCP queue, where passengers transition to a mini queue for a

³¹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 4.1.2, 2010

³² IATA ADRM 10th Edit, Section 3.4.19.2, 2017

particular SSCP lane. In addition to reviewing the passenger's ID and boarding pass, the TDC officer sometimes directs passengers which lane to use.

b. Queuing

An appropriate space allocation should be made on the non-sterile (public) side of the checkpoint for passenger queuing. This space should include room for tables near the screening equipment, for preparing their belongings for screening³³.

c. Screening Lanes

1. Passenger Screening

The walk-through metal detector (WTMD) is used for passenger screening. It is an archway used to detect concealed metallic items and/or contraband³⁴.

The Advanced Imaging Technology (AIT) provides an additional element of passenger screening by being able to detect a broad spectrum of materials concealed in or under a passenger's clothing³⁵.

2. Carry-on Bag Screening

Carry-on bag screening is mandatory at a SSCP and is accomplished by deploying advanced technology (AT) equipment. Generally, this equipment has the following components³⁶:

- Loading Table/Entrance Roller
- Queuing Conveyor & Hood (Vendor Specific)
- Scanning Belt & Dome
- High Speed Conveyor (HSC) & Hood
- Extension Rollers
- Exit Roller with Bag Stop
- Manual Diverter Roller (MDR)
- Alternate Viewing Station (AVS)

Transportation Security Officers (TSOs) are staffed dynamically at the carry-on bag screening units where one or two screeners can perform the functions listed below:

- Review bag images on the monitors
- Remove alarmed bags from the alarm bag cutout or from the MDR
- Place empty bins on the bin carts

Refer to Part 2, Section h for calculations for the number of screening lanes, and dimensional guidelines and standards.

³³ TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 2.1.2, 2014

³⁴ TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 2.7, 2014

³⁵ TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 2.8, 2014

³⁶ TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 2.5, 2014

Airports are currently implementing the Automated Screening Lanes (ASL) which strengthens security, increases operational efficiency and improves passenger experience. Due to its new configuration, multiple passengers can divest their belongings simultaneously. Another difference with the conventional screening lanes is that the passengers place all their belongings into bins (each of which has a unique Radio Frequency Identification (RFID) for positive tracking) and push the bins onto the automated belt. A camera photographs all the bins before entering X-ray. If a bin contains an alarm item, it will be diverted to a secured belt for additional screening. The recomposure station provides space for several bins, allowing several passengers to collect their belongings at the same time. At the end of the recomposure line, bins are placed on an elevator which leads to a conveyor that returns them to the divestiture station automatically.

Due to the additional equipment, ASL requires more space in the security screening zone than the conventional screening lanes. However, each lane processes 30% or more passengers per hour than a traditional lane.

d. Trusted Traveler (TSA PreCheck, Clear)

Trusted traveler systems allow passengers to voluntarily register, subject themselves to a criminal background check, and pay a fee to gain status as a trusted traveler. Once this status is attained, they are subject to less stringent requirements at the SSCP, allowing for a streamlined process. This may include not having to remove shoes and belts, and not having to remove laptops and liquids from carry-on bags.

Airports who recognize trusted travelers should create a strategy for the accommodation of trusted travelers as part of the development proposal. This can be done by setting aside a few lanes at a security checkpoint, or providing an entirely separate checkpoint for trusted travelers. The lanes for trusted travelers run faster than traditional screening lanes.

e. VIP Screening

Some airlines or terminals may wish to provide separate VIP screening areas for politicians, diplomats, celebrities, other public figures, or highest-level premium passengers. These VIP SSCP lanes are often separated from the traditional SSCP lanes to maintain the privacy of the person. It is up to the airport officials' and/or airlines' decision to have separate private screening areas for VIP passengers or alongside other traditional screening lanes.

f. Known Crewmember (KCM)

Known Crewmembers (KCMs) include uniformed pilots and flight attendants who are reporting for flight duty. They have airline credentials often including biometric verification. KCMs may be admitted to the secure side via separate passageways independent of the SSCP where their credentials are checked by a screener, or they may utilize Trusted Traveler SSCP lanes. If using SSCP lanes, their numbers should be added to the total peak hour demand for passenger SSCP lanes.

g. Secondary Search

Following the initial steps of security screening at the checkpoint (X-rays for carry-on baggage, walkthrough metal detector or body scanner for passengers), certain passengers and/or bags are

identified by the TSA for secondary searches. Secondary search areas are provided at the end of each lane. These are comprised of a baggage inspection table and pat-down area.

h. Private Screening

A private room or booth must be provided for personal searches of passengers requesting privacy for pat-downs, or at the TSA's discretion.

i. Recomposure

The recomposure area is the area after the screening where passengers can retrieve their screened bags and restore their composure. Egress seating after the checkpoint is used for passengers to sit down and compose themselves with their personal belongings after completing the screening process. The screening experience is greatly improved if passengers can sit down to put their shoes and jackets on.³⁷

In addition to the minimal recomposure areas provided in the standard TSA lanes, designers are encouraged to provide additional recomposure areas, including adequate space and comfortable furniture such as cushioned benches, chairs, and tables. For most passengers, the TSA checkpoint is by far the single most stressful part of the passenger experience, and a well-planned recomposure area can alleviate much of this stress. The recomposure area should provide passengers a dignified and comfortable place to put back on their shoes, belts, other clothes, and re-pack their carry-on bags. It should include visual cues for intuitive wayfinding to retail concessions and gates.

Providing an ample and pleasant recomposure area has been shown to provide two tangible benefits:

- Improved lane throughput performance (passengers per lane per hour), because when all passengers have a welcoming place to go for recomposure, they tend to go there quickly, which eliminates the bottleneck of passengers attempting to recompose at the roller-beds immediately at the output end of the x-ray machines. When passengers attempt to recompose here, they can back up the x-ray output as well as block the queue of passengers attempting to access their cleared bags from the roller-bed.
- Measurably happier passengers. The de-stressing power of a good recomposure area can improve customer service ratings, and increase retail spending rates.

4. Post-Security Area / Concourse

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.

- 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.
- Concessions, including food/beverage, retail, news/gifts, and services.
- Public corridors and restrooms.

³⁷ TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 2.13, 2014

a. Circulation

General public circulation includes the horizontal and vertical circulation elements of all of the corridors and other architectural spaces, which tie the public functional elements of the terminal together. The list below shows the considerations when planning for circulation space:

- Primary circulation pathways
- Non-public circulation pathways
- Moving walkways
- Elevators
- Escalators
- Stairs
- Ramps
- Automated People Mover (APM) Systems

Passenger journeys should be as straightforward as possible with clear sightlines to approaching decision points. Simple direct routes are preferred, with adequate width for passengers to move freely. Walking speeds vary considerably so ample space is required for individuals and small clusters of people to pass each other. Passengers with Reduced Mobility (PRM) should also be provided with ample circulation space and with rest areas at appropriate intervals. The circulation route also needs to provide ample space for electric vehicles (passenger electric carts, etc.) to move freely, back and forth without inconveniencing or endangering passengers on foot³⁸.

Changes in direction should be avoided wherever possible. Wherever unavoidable, they should be as shallow as possible with ample maneuvering space for all passengers and, where provided, electric vehicles.

b. Holdrooms

A gate holdroom is where departing passengers wait for and ultimately board flights. The following are primary components that comprise a gate holdroom³⁹:

- Preboarding waiting area – designated space where passengers wait to board a flight. Area includes seating and standing areas for passengers.
- Agent gate podium and queuing - area where passengers queue and ultimately communicate with airline representatives regarding flight information, make last minute changes to reservations and/or seating assignments, receive upgrades, and may gate-check bags. For flights out of the US, agents review passport and visa information.
- Boarding/egress corridor - designated area near the gate that is used for queuing of passengers to board the aircraft, and for passenger egressing from the aircraft when it arrives at the gate; individual airlines have differing boarding and egress procedures. Main circulation corridors and concessions are outside of the holdroom area and passengers should not queue or wait in these

³⁸ IATA ADRM 10th Edition, Section 3.4.10.1, 2017

³⁹ FAA AC 150/5360-13A, Section 6.4.4, 2016 (Draft)

areas to access their holdroom. Maintaining sufficient clearance in the main circulation corridors is necessary to access emergency exits in case of an emergency event.

Holdroom requirements are based on the assumption that each individual holdroom serves an individual gate. Minor reductions in holdroom requirements may be allowable when there is a legitimate opportunity for passengers to use an adjacent holdroom. An adjacent holdroom is defined as one with a seating area contiguous with the seating area of the gate in question, where passengers can see the podium and hear announcements from the gate in question. Contiguous seating areas are those that are not separated by concessions, circulation corridors, or other obstructions.

It is desirable to have natural light through windows and or skylights, concessions within a reasonable walking distance, and a view of the apron and in particular the aircraft associated with the holdroom.

c. Restrooms

Refer to Part 1, Section 7.

d. Concessions

Concessions development, at PANYNJ Airports, aspires to achieve a world class level of service for all short term, intermediate, and long-term development. Terminal concessions programs will be planned at a level of quality above the current operations of such concession programs at PANYNJ Airports and to develop and operate at a premier first-class concession program. A “premier first-class” concession program is one that consistently performs above the average of airports of similar size and a similar passenger profile on industry-recognized surveys, including the Port Authority-sponsored surveys, which contain evaluations or ratings of passenger terminal concession programs, or specific components thereof, of the same type or class. The criteria set forth in this section establishes a minimum performance bench mark.

Providing passengers with a variety of high-quality retail, food and beverage and personal service concessions are important. Departing passengers often perceive a higher quality travel experience if they have diverse opportunities to shop, eat or receive personal services while waiting for their departing flight. As in-flight food services continue to be reduced, preflight access to food and beverage offerings is becoming increasingly important. Arriving passengers may also seek opportunities to purchase duty-free products or gifts before leaving the terminal⁴⁰.

Revenues that flow from concessions sales can provide significant income.

Airport concessions are an important component in terminal space programs. The following are some of the types of concessions to be considered when developing concession space program requirements⁴¹:

- News/gift: Newspapers and magazines; Convenience items and sundries
- Specialty retail: apparel, souvenirs, gifts, sunglasses, jewelry, personal care/health products, entertainment products (movies, music, others), and prepackaged food and wines.

⁴⁰ IATA ADRM 10th Edition, Section 3.4.14.1.1, 2017

⁴¹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter III, Section 9.3.5, 2010

- Food and beverage: Food courts and other self-service units, full-service restaurants, cocktail lounges and bars, coffee stand and vending machines.
- Duty-free/Duty-paid shops
- Services: massage, spa, entertainment (arcades, movie rentals, others), pay-per-use passenger lounges, business centers, currency exchange, luggage storage and wrapping, hair salon, barber, medical services, shoe shine and post office.
- Advertising
- Online and social media driven commerce

ACRP Report 54, Resource Manual for Airport In-Terminal Concessions, provides more detailed explanations and best practices for developing a concession program.

e. Airline Customer Service

Airline information and ticketing desks should be provided within close proximity to all holdrooms. Passengers can be supplied with information regarding delayed or cancelled flights, and can be issued revised tickets. Additional troubleshooting services can also be carried out. Bag drop or bag processing facilities can be provided where applicable⁴².

Where airlines have a large and/or hubbing operation, they may provide a separate bank of service counters not associated with a particular gate, which serves passengers who wish to re-book for earlier or later flights, missed connections, etc.

f. Premium Lounges

Airlines provide club facilities based on their individual criteria for level of passenger activity, type of market (business vs. leisure), the number of club members in a given airport market area, and so forth. The size of these clubs can vary significantly and, at hub locations, can be quite large. These areas include exclusive-use membership clubs run by individual airlines (American’s Admirals Club, Delta’s Crown Room, United’s Red Carpet Lounge, etc.), international premium class lounges, and special services facilities⁴³.

1. Common Use

Terminal operators or other non-airline entities may wish to provide common use premium lounges, which can be pay-per-use or have usage agreements with major airlines that do not provide a premium lounge at that airport. Although previously rare, these are becoming more commonplace, especially in terminals with many airlines but no dominant airline.

g. Nursing Rooms (Lactation/Wellness Rooms)

It is a growing trend to provide additional amenities for passengers, such as mother nurseries, changing rooms, and family rooms, although it is not addressed in local or national building codes. These

⁴² IATA ADRM 10th Edition, Section 3.4.11.13.2, 2017

⁴³ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.11.4, 2010

amenities are needed for caregivers traveling with young children and babies as well as nursing mothers who need a private space.

h. Water Filling Stations

Water filling stations provide access to drinking water for passengers so that they can stay hydrated throughout their stay at the airport and on their flight. Since security rules were tightened several years ago, passengers are not allowed to take liquids, including water, through the security check. Providing multiple water filling stations for passengers to refill their water containers post-security helps to improve the travel experience at airports.

i. Children's Play Areas

Child play areas are important in serving families, and should be provided at strategic locations throughout the secure area. These areas may be located near toilet facilities that include "baby changing" and other family-focused facilities to enhance convenience⁴⁴.

j. Pet Relief Areas

Provision should be made for a well-maintained animal service area (included but not limited to guide dogs and other assistance dogs) used by people with reduced mobility. The route to this area must be signed, with level access, and be well lit. Assistance from staff should be available upon request. Appropriate relief areas should be available, where practical, both landside and airside⁴⁵.

5. International Arrivals

Refer to Airport Design Guidelines by U.S. Customs and Border Protection (CBP) for latest updates. 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) Federal Inspection Services (FIS) facility for immigration and customs processing prior to gaining entry into the United States. CBP can also use Preclearance operations that stations CBP law enforcement personnel overseas to inspect travelers prior to boarding U.S.-bound flights. Through Preclearance, CBP Officers conduct the same immigration, customs, and agriculture inspections of international air travelers typically performed upon arrival in the United States, before departure from foreign airports.

There are two separate procedures once passengers arrive to the FIS facility; Immigration, which assesses the passenger's ability to enter the United States, and Customs, which assesses the suitability to enter the United States for any items, such as baggage and monetary instruments that may be transported by the passenger. Within the Customs inspection, a separate inspection may be performed by the US Department of Agriculture (USDA) as part of their Animal and Plant Health Inspection Service (APHIS).

For many aspects of the design of the international arrivals hall, specifications will be found in the CBP FIS Facility Planning and Design manual. This manual should be considered as a controlling document, and any local standards or desires from a specific air carrier must be evaluated with regard to any

⁴⁴ IATA ADRM 10th Edition, Section 3.4.11.13.2, 2017

⁴⁵ IATA ADRM 10th Edition, Section 3.4.15.5.6, 2017

potential conflicts with the official CBP guidance. In all cases, deviations from the CBP manual must receive CBP approval before any physical work begins.

a. Sterile Corridor

Arriving international passengers must be kept separate from other passengers, visitors, or unauthorized airline employees until they have cleared all FIS inspections. Therefore, a separate corridor system from the aircraft gate to primary inspection is required. The corridors should be sized for single-direction passenger flow. Depending on the distance from gate to primary inspection, moving walkways or APMs may be appropriate. Because departing passengers can use the same gates as international arrivals, control doors and monitoring of the corridor system is required to prevent mixing of arriving and departing passengers⁴⁶.

Passengers with special needs may be met by airline or contract staff to be escorted through the various processes. All non-CBP staff working in the FIS must be approved by CBP to enter the screening area. The FIS is not a security-sterile environment and personnel with access to the FIS must be TSA-screened before entering the secure departures area of the terminal.

b. International In-Transit Lounge for Passengers Not Entering the US

All passengers boarding flights bound for the United States must have documentation showing their ability to present for entry through the guise of a US Passport, US Permanent Resident card, US Immigrant or Non-Immigrant Visa, or a passport from a country with a Visa Waiver agreement. All passengers are inspected for entry upon first arrival in the United States and must be granted admission, even passengers who have no intention of leaving airport property and are only in the United States for an onward flight leaving the US. Transit visas are somewhat rare, with only 21,080 issued in FY 2016 out of over 10 million total non-immigrant visas.

In the event that direct airside transit is restored, this requirement will be revisited.

c. Immigration (Conventional Option)

Primary Inspection: Passengers have passport identification checked, and declare checked baggage items.

The passengers' documents are examined by a CBP officer, an automated background check is performed, and an interview takes place to determine the passenger's motivation for travel to the United States and suitability for admission. If the officer believes that more information or documentation is required beyond what can be established at this interview, he or she will refer the passenger to secondary screening. The officer will also ask questions to determine if the passenger must be mandatorily referred to either Customs or Agricultural screening that is more extensive than what will be encountered during the standard processing flow. If the officer decides the passenger is suitable for admission, he or she will be directed onwards, to baggage claim or the FIS exit.

The number of booths required for primary inspection is typically prescribed by the CBP based on the design hour passenger volume and, as such, consideration of dynamic issues will not usually impact that

⁴⁶ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.1, 2010

aspect of the facility. However, while agencies may specify minimum queue depths, they may be insufficient depending on the likely distribution of peak hour passengers amongst flights and the relative timing of those flights. Examining demand in a smaller time frame, 15 or 30 minutes, is often helpful in understanding the maximum length of queue to be accommodated. One other key area to consider in arrivals facilities is the impact of off-time (i.e., early or late) flights. In addition to a base analysis, if off-time data is available, a number of sensitivity tests should be performed to fully understand the dynamics of the facility⁴⁷.

CBP periodically updates standards and procedures, refer to ACRP Report 61 and Customs and Border Protection (CBP) FIS Facility Planning and Design for further design considerations for immigration. The latter document is a confidential document and may be obtained through CBP.

d. Immigration (Automated Primary Option)

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, conventional unstaffed primary inspection booths are being replaced by kiosks for passengers to complete the primary inspection process.

Passengers at these kiosks scan their identity documents, answer basic questions, and are algorithmically passed or referred to a conventional primary inspection booth. The passengers who have been passed then present themselves to a CBP agent for an interview that is shorter and less space-intensive than the standard practice. Because the interaction is shorter, fewer agents are required to process the passengers. At this point, the agent can either clear the passenger to proceed to baggage claim and the Customs part of the inspection, can refer the passenger back to a standard primary inspection booth, or refer the passenger to secondary screening. These latter two examples should be considered rare, as the majority of the criteria for referrals have been pre-determined at the kiosk.

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.

e. International Bag Claim System

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 international baggage claim areas.

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

⁴⁷ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.2, 2010



Figure 37: Sloped Plate Baggage Claim

Sloped plate carousels are typically 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.



Figure 38: Flat Plate Baggage Claim

Flat plate racetracks are typically 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 typically 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.

Baggage claim for international flights is located in the CBP FIS facilities, downstream of document check (passport control), and is part of the sterile area.

After primary inspection, passengers proceed to international baggage claim. The approach in sizing a baggage claim for an FIS is similar to that of a domestic baggage claim. However, the time a claim unit is in use is typically longer for two reasons⁴⁸:

- Checked baggage ratios and the percentage of passengers with checked bags are typically higher than for domestic flights, thus requiring more time to unload. All passengers entering the United States must also have CBP baggage inspection at the first point of entry. Connecting passengers then re-check bags to their final destination.
- Because passengers must clear the CBP primary area before entering the baggage claim area, bags may be on the claim unit before passengers are present. This delay can require a claim unit with greater capacity for baggage storage than is required for domestic flights. Thus, an international claim unit may be sized more for baggage storage than for active claim frontage, although both aspects should be considered. If sufficient storage isn't available (or passengers are delayed at the CBP primary area longer than anticipated), airline employees may have to unload bags from the claim unit and place them on the floor or shelves for passengers to pick up.

1. Oversized Baggage

Facilities should also be provided for odd-sized or oversized baggage, such as golf clubs, skis, and packages that are too large to fit on the baggage claim units or may cause jams on feed conveyors.

f. Airline Baggage Service Office

Baggage service offices (BSO) include both passenger service counters and waiting areas, as well as storage for late or unclaimed bags. Full baggage offices are typically required only by airlines with sufficient activity to warrant staffing. Other airlines often will request baggage lock-up areas to store late or unclaimed baggage and will handle passenger claims at their ATO counters⁴⁹.

g. Baggage Carts

Baggage carts, also known as "trolleys", are provided as an amenity to passengers so they may wheel large heavy baggage around the airport terminal and nearby ground transport facilities. They are normally limited to landside areas where checked baggage is handled by the passenger, e.g. for departing passengers, from curbside, parking garage, or transit station to the check-in hall; and for arriving passengers, from baggage claim to curbside, parking garage, or transit station; although in some airports, a small provision of baggage carts is located within the airside areas, close to the concessions.

1. Design Considerations

- Terminal facilities should be designed with large, clear paths so that the cart trains can be maneuvered through.

⁴⁸ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.3, 2010

⁴⁹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.11.2, 2010

- Baggage cart origin stations should be placed along these wide paths.
- Terminal building layout should allocate appropriate areas and consider means for collection, storage, return to and replenishment of cart origin stations.
- Terminal building designers should check the cart manufacturer’s specifications for appropriate dimensions for the clear paths, including minimum width, and minimum turn radius.

Baggage cart concept of operations including floor plans with baggage cart deployment locations and train paths shall be submitted to the Port Authority for review and approval.

h. Customs

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.

This is the final step in the overall entrance examination. Once passengers have been cleared through Customs, they may proceed out the exit door to the landside portion of the terminal, at which point they are free to utilize onward air or ground transportation.

i. Secondary Screening (Public Health, Agriculture, Fish & Wildlife, etc.)

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.

This will take place in a separate and enclosed section of the FIS facility. The specialized space and equipment requirements for this secondary area are contained in the CBP FIS Facility Planning and Design manual. The APHIS screening typically involves trained dogs sniffing passengers’ baggage, and appropriate provisions must be made in back-of-house areas for the requisite animal welfare.

j. FIS Exit Control

Upon attaining all immigration and customs clearances, passenger and their bags are considered “bonded” and allowed to enter the USA. A final document check and exit portal is required. FIS exit is a one-way process, typically with a frosted glass door or other visual methods employed to block continuous view into the screening areas. Staff from either CBP or local services will be placed to prevent entry into the CBP screening area by members of the public from landside through the exit door.

It should be noted that bonded passengers are not security screened. Newly arrived international passengers who will be taking a connecting flight (whether domestic or international) must go through security checkpoints, and their baggage must be screened, similar to originating departing flights.

k. International Recheck (Passenger and Baggage)

International passengers connecting to a domestic or international departing flight must clear all CBP inspections at their first point of arrival in the United States. Thus, after completing all the FIS procedures, connecting / transfer passengers must re-check their baggage. The re-check counters

should be located between the FIS exit and the meeter/greeter lobby so that the connecting passenger does not have to transit the meeter/greeter lobby with bags⁵⁰.

It is optional for airlines to elect to provide this service at the exit from the FIS. Airlines that choose to provide international recheck service may be those with higher customer service standards or with their departure facilities in a different terminal than the FIS. The recheck counters may be dedicated to an airline or in a common-use arrangement, facilitated by a ground handler, or with space time-shared between airlines depending on their intraday peaks.

l. Meeters / Greeter Area

After exiting the FIS, locally terminating passengers enter a meeter/greeter lobby, which will also provide access to ground transportation and other arriving passenger services. The meeter / greeter lobby should have seating for a proportion of the meeters/greeters. However, seating may account for a smaller portion of the area with greeter standees and passenger circulation through the space making up the bulk of the area⁵¹. The number of meeters and greeters is often influenced by the local/regional culture. So, specific information should be sought for each airport project.

m. Concessions

Refer to Part 1, Section 4.

n. Restrooms

Provide restrooms along the sterile corridor, and/or before the queuing areas for CBP processing. Special consideration must be given to the trash collection from these restrooms, because they are frequently used as a disposal area for weapons or contraband that passengers fear might be discovered in the immigration and customs inspection process.

Refer to Part 1, Section 7.

o. General Visitor Information

All airports require some way of providing information to arriving passengers who may not be familiar with the airport or its region. Airports are using every marketing and public relations tool available to build a positive customer service image and make a favorable impression on travelers and visitors as they pass through their facilities. The customer service centers, information counters, and kiosks strategically located in the terminal assist passengers and visitors by addressing their questions, comments, or concerns. The range of services offered at such information centers might include flight, airport, and city information; directions; lost and found; local phone calls; in-terminal paging services; valet and ground transportation coordination; etc. These tools can be simple information displays and counters with local brochures up to staffed counters or customer information centers⁵².

⁵⁰ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.5, 2010

⁵¹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.6, 2010

⁵² ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.6 & 3.14.4, 2010

6. Domestic Arrivals

a. Backflow Prevention / Exit Lanes

Arriving passengers exit from the post-secure to the pre-secure area through a hallway or portal that has one-way control, either staffed or automated. This may be located near the SSCP or away from it.

A staffed backflow prevention corridor is comprised of a manageable width and sufficient length to give visual control to the officer on watch, so that he or she can see and prevent approaching persons walking the wrong way, attempting to reach the post-secure side. Supplementing the staff person, there are cameras and motion detectors, which sound an audible and visual alarm if they detect a person walking in the wrong direction.

Automated exit lanes are comprised of a series of automated one-way doors designed to allow passengers to exit the secure side, but not move in the other direction. They are also supplemented by cameras and motion detectors, which sound an audible and visual alarm, and lock the doors if it detects a person walking in the wrong direction.

b. Domestic Arrivals / Baggage Claim Hall

The arrivals hall is a portion of the terminal where public access is unrestricted. This area must accommodate sufficient space for arriving passengers and their meeters/greeters, as well as the required number of baggage claim devices. The arrivals hall also provides areas for ground transportation centers, concessions, restrooms and other amenities to satisfy users' needs and contribute to a satisfying experience while at the airport. Such amenities include city and transportation information, rental car counters, concessions space, seating, and support areas such as restrooms and mechanical spaces⁵³.

It should be noted that although domestic baggage claim facilities typically form part of some arrivals halls at US airports, this is less common in other countries because of concerns about theft and general security. In these terminals, only arriving passengers have access to bag claim, and after they claim their bags, they go through a secure portal into the arrivals hall where the meeters / greeters waiting area is located.

c. Domestic Baggage Claim System

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 baggage claim areas. Domestic baggage claim is typically located in non-secure areas of airport terminals with direct access to the curbside and accessible to meeters/greeters.

Unload areas for inbound (arriving) domestic bags are usually co-located with outbound (departing) baggage makeup areas. For additional information on baggage claim devices refer to Part 1, Section 5. e.

⁵³ IATA ADRM 10th Edition, Section 3.4.13.5, 2017

d. Airline Baggage Service Office

Refer to Part 1, Section 5. f.

e. Baggage Carts

Refer to Part 1, Section 5. g.

f. Meeter / Greeter Area

The arrivals hall provides a short-term waiting area for visitors (meeters and greeters) waiting for arriving passengers. It may be co-located with the baggage claim hall, or between the baggage claim hall and the landside curbs, providing dedicated circulation and waiting areas that should be dimensioned to accommodate the expected flows of passengers and visitors. It should also cater to the use of baggage carts⁵⁴.

Visitors will access the arrivals hall from the landside forecourts. The number of meeters and greeters is often influenced by the local/regional culture. Therefore, specific information should be sought for each airport project.

g. Concessions

Refer to Part 1, Section 4.

h. Restrooms

Refer to Part 1, Section 7.

i. General Visitor Information

Refer to Part 1, Section 5. o.

7. General Public Areas

a. Circulation

Refer to Part 1, Section 4.

b. Conveyance systems

References:

- ACRP Report 25 - Airport Passenger Terminal Planning and Design
- ACRP Report 67 - Airport Passenger Conveyance Systems Planning Guidance
- ACRP Report 117 - Airport Escalators and Moving Walkways
- IATA Airport Development Reference Manual 10th Edition

Passenger conveyance systems are pieces of equipment in airports that help to physically move people such as escalators, elevators, stairs, moving walkways, and passenger assist vehicles/carts. A critical

⁵⁴ IATA ADRM 10th Edition, Section 3.4.13.5.1, 2017

factor affecting passenger circulation at the airport is the capacity of the conveyance systems and their ability to handle passenger demand throughout the day.

Level changes can be achieved through ramps that have gentle gradients and wide enough space to enable Passengers with Reduced Mobility (PRM) and passengers with wheeled baggage and/or children in strollers to move freely and pass each other.

Any change of level that cannot be achieved by gentle ramps must be provided with satisfactory modes of mechanical vertical circulation. People mover systems are critical in moving passengers between terminal buildings and transferring them between their associated concourses and satellite or remote gates. These systems, which aid in the movement of passengers, include moving walkways, APM, escalators, and elevators⁵⁵.

- **Escalators.** Typically, escalators provide the primary means of transport for large numbers of people between floors.
- **Elevators.** Passenger elevators are required for handicapped travelers, passengers with large bags and/or baby strollers, and others who either cannot or will not use escalators or stairs.

Passenger walking distance, ease of use, and the positioning of conveyance systems with regard to passenger flows must be considered when passenger terminal facilities are planned. In all airports, elevators and escalators are used to provide vertical circulation for passengers, while moving walkways, passenger assist vehicles, and wheelchairs are often used to facilitate horizontal movement through airports with longer walking distances.

c. Moving Walkways

A moving walkway is a slow-moving conveyor mechanism that transports people across a horizontal distance, providing an efficient means of traveling horizontally through terminal areas and reducing travel time through terminals for those who choose to walk on the walkway equipment. This system can either be manufactured as a pallet or moving belt style.

1. Walking Distance

Walking distance for departing passengers is defined from security screening checkpoint (SSCP) exit to the farthest gate(s); whereas walking distance for arriving passengers is defined from the farthest gate(s) to immigration control or baggage claim.

A series of moving walkways should be considered in terminals with walking distances over 1,000 feet⁵⁶. This is consistent with the International Air Transport Association (IATA) Airport Development Reference Manual (ADRM), which recommends routes with walking distances of over 300 meters (985 feet) should be augmented with moving walkways.

⁵⁵ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.10.6, 2010

⁵⁶ ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.1.5

2. Moving Walkway Width

Depending on the manufacturer, the pallet width (clear width for walking) for an airport moving walkway is 48-56 inches. The overall outside edge-to-outside edge width for the moving walkway ranges from 66-84 inches, and maximum possible lengths vary by manufacturer. Figure 39: Dimensional Example of a moving walkway

represents a typical moving walkway with common dimensional criteria. The width used for planning double moving walkways (e.g., one in each direction) are 12-15 feet, including allowance for a 1-foot buffer between the two walkways⁵⁷.

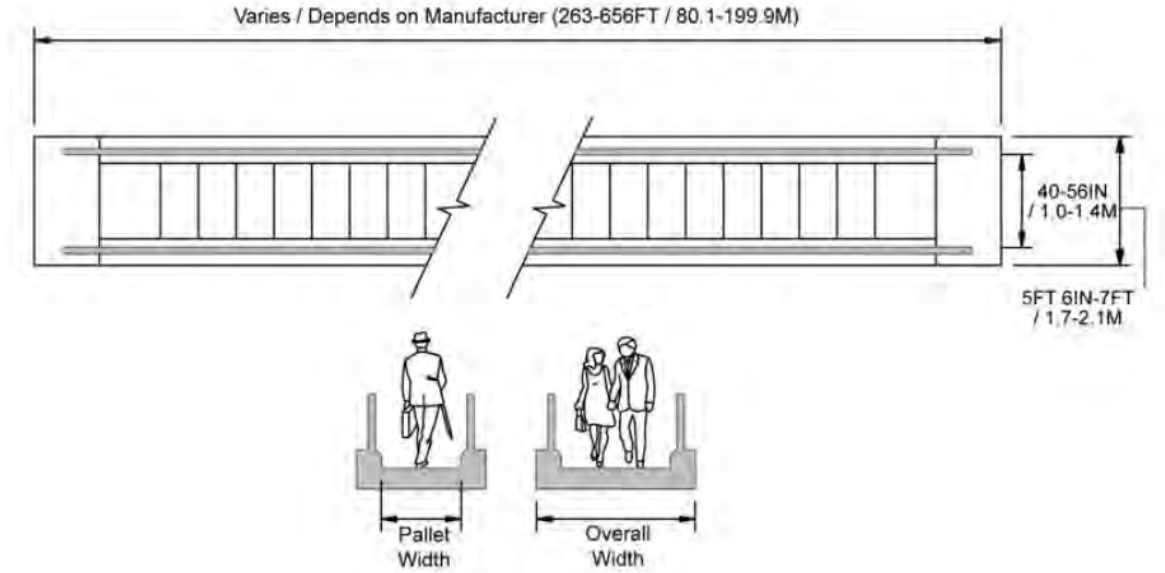


Figure 39: Dimensional Example of a moving walkway⁵⁸

In airport applications, the narrow widths can be problematic, wider pallet widths can allow people to pass one another, even with luggage. Designers should specify the higher width for longer moving walkways, to allow walking passengers to easily pass standing passengers with little to no interference.

3. Angle / Maximum Rise / Maximum Length

The maximum length of a moving walkway ranges from 164 to 656 feet, but a practical maximum length is around 300 feet per unit⁵⁹. Due to emergency egress requirements, moving walkways at Port Authority airports may be no longer than 150 feet.

Certain systems can be constructed with an incline. Moving walkways at Port Authority facilities shall have a maximum inclination angle of 3 degrees for segments within 36 inches of the entry and exit ends, and no more than 12 degrees at any point⁶⁰.

⁵⁷ ACRP 25 Airport Passenger Terminal Planning and Design, Vol 2

⁵⁸ ACRP 25 Airport Passenger Terminal Planning and Design, Volume 2: Spreadsheet Models and User's Guide

⁵⁹ ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.1.1.2

⁶⁰ ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.1.1.2

4. Entry Clear Area

The absolute minimum clear area in front of the entry zone of moving walkways should be twice the distance between the centerlines of the handrails. This distance should provide sufficient queue space to accommodate passenger surges and, if applicable, designers should consider the effects of other pedestrian cross-traffic passing through the queuing area. Queuing is often generated by peak passenger surges at the walkway entry. As a result, planners must analyze the peak 10 to 15-minute period to account for pedestrian surges on conveyance devices. Assessments of baggage quantities should also be estimated because this will affect space requirements per person and per party. Typical area queues range from 13 square feet per person (sfpp) to as much as 17 sfpp.

5. Landing Clear Area

Minimum clear area at the exit zone of moving walkways should be 30 feet. As a practical planning rule, if multiple moving walkways are operating in succession, this safety zone must be provided independently for each moving walkway. Further, the provision of suitable queuing area at the entrance and the exiting end of moving walkway must consider the effects of all pedestrian traffic passing through the area, whether or not the pedestrians are using the moving walkway system.

6. Concession Location in Relation to Moving Walkways

Planners should carefully consider the arrangement of moving walkways with respect to retail concessions, such that the moving walkways do not bypass concessions, which is inconvenient to passengers who have to double back to patronize the concessions, and may be dissuaded from doing so if the walking distances are long. As indicated in Figure 40, it is preferable to locate concessions either adjacent to a moving walkway or between successive moving walkways.

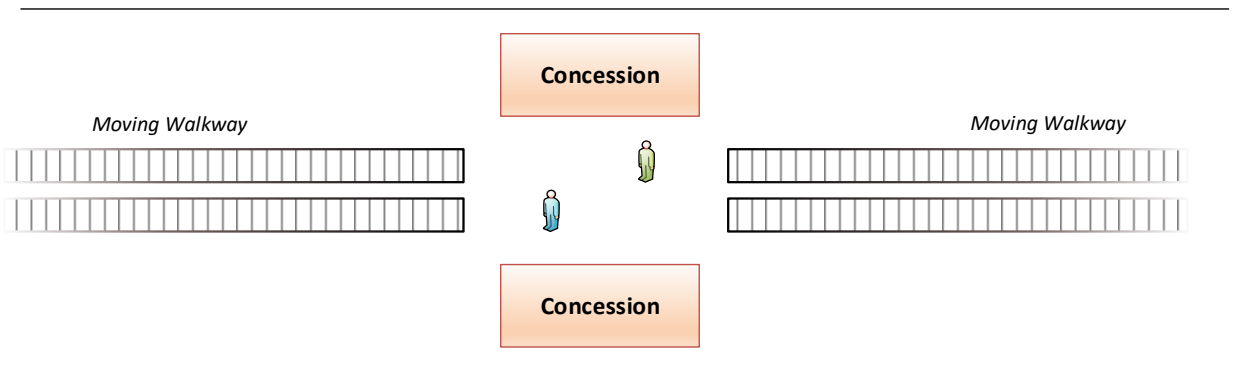


Figure 40: Preferred Arrangement of Moving Walkways and Concessions: Concessions Readily Accessible⁶¹.

7. Safety and Signage

Passengers using a moving walkway may not recognize that they are approaching the end of the walkway where they must transition to walking. Falls can result. Signs and recorded announcements can

⁶¹ Arup

mitigate accidents but cannot eliminate them. Signs and/or announcements should also be used to prohibit passengers in wheelchairs or with baggage carts from using moving walkways⁶².

d. Escalators

Escalators and/or ramps should be provided at all level changes along passenger flow routes. Stairs may also be included as a contingency measure in the event of escalator maintenance or breakdown, or for passengers who prefer them. Escalators are the preferred method for moving most passengers quickly from level to level, but they must be accompanied by elevators to ensure that passengers with reduced mobility (PRM) and passengers with substantial amounts of baggage and/or baby strollers are provided with an equivalent, speedy, and straightforward method of making the level change⁶³.

1. Capacity

Human factors play a large role in escalator capacity with arrival rates and person-to-person spacing influencing the rate at which escalators move people. Based on common practice among airport terminal planners, design capacities are typically estimated at 50 people per minute (ppm) in the down direction and 60 ppm in the up direction if location-specific data is not available⁶⁴.

2. Step Width

Observed passenger behavior on escalators in airports is generally one person on every other step on a 32-inch-wide escalator and one person per step on a 48-inch-wide escalator. At airports which experience a higher percentage of pleasure flying or serve tourist destinations, a 48-inch-wide surface better accommodates baggage⁶⁵.

3. Maximum Rise

The angle of inclination of any escalator shall not exceed a maximum of 30 degrees⁶⁶.

4. Queue Area

The termination points of an escalator must not be in a confined or restricted processing area where “back flow” might occur⁶⁷.

Safe design provisions must include ample space to allow entering and exiting, especially in the space between successive escalators. A minimum of 30 feet of queuing and run-off space, as measured from the escalator comb is preferred, to clear to any obstruction at the top and bottom of each escalator.

⁶² ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.1.3

⁶³ IATA Airport Development Reference Manual 10th Edition, Section 3.4.10.2

⁶⁴ ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.1.4

⁶⁵ ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.2.1.3

⁶⁶ ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.2.1.2

⁶⁷ IATA Airport Development Reference Manual 10th Edition, Section 3.4.8.1

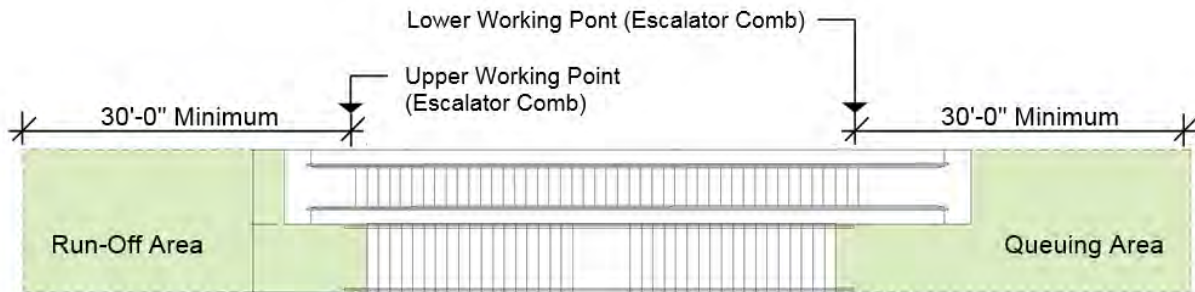


Figure 41: Queuing and Run-off Space for Escalators⁶⁸

The width of the zone shall be not less than the width between the centerlines of the handrails plus 8 in. The length of the zone Space shall be provided to accommodate all traffic in the safety zone. If multiple escalators are operating in a serial configuration, this safety zone must be provided independently for each escalator (shown in Figure 42)⁶⁹.

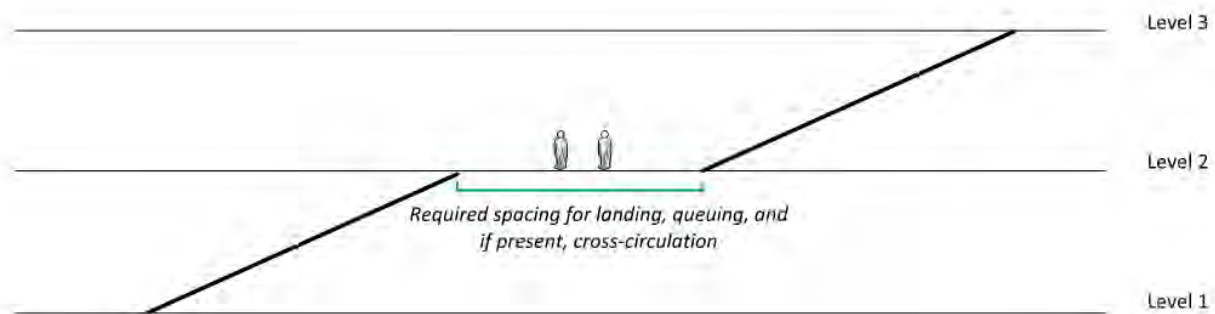


Figure 42: Boarding Area between Successive Escalators.⁷⁰

Further, the provision of a suitable queuing area at the entrance as well as adequate space for exiting must accommodate composite flows of all pedestrians moving through these areas without hindering movements to and from the escalator. Finally, in configurations where escalators cascade sequentially and a landing area is created where people transfer between escalators, ample space must be provided to absorb fluctuating exit and entry flows and cross-flows, if present, between successive escalators to avoid potentially hazardous conditions associated with pedestrian cross-flows at different directions and speeds. To the extent possible, designers should avoid creating arrangements where there will be cross-circulation between successive escalators.

5. Number of Escalators

Escalator boarding rates for passengers going up are higher than for passengers going down. In general, it is believed that passengers slow their boarding rate when going down if the entire escalator is not visible from their point of view.

⁶⁸ Port Authority PATH – Harrison Station Planning Standards

⁶⁹ ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.2.1.4

⁷⁰ Arup

As the number of escalators is increased the ability to move more people increases, but the increase is not linear. For example, the addition of a second escalator doubles capacity but may not double throughput. The boarding rate per individual escalator is dependent on the use and placement of the escalator bank. When bulk queues form in front of multiple escalators, the effect of people moving through the larger queuing space and the additional decision time associated with choosing escalators can regulate or meter the flows onto the escalators. This can result in lower boarding rates for multiple, adjacent escalators.

Escalator quantity should be determined by demand and should be able to accommodate waves of arrivals. For instance, if escalators provide terminal access from an automated people mover station, the escalators should be able to clear one trainload of arriving passengers before the next train arrives.

e. Elevators

Elevators shall be conveniently located for all customers and facilitate access for the mobility impaired and the disabled. Elevators shall be provided with a queuing area to permit passengers disembarking the elevator to exit without interference from those waiting. Elevators shall be located so as to not obstruct general passenger circulation or visually obscure other vertical circulation elements along the path.

1. Elevators Use in Relation to Location

The location of the elevators relative to the security checkpoints affects use. Elevators located prior to security points have higher utilization because they carry passengers with a higher number of bags. In contrast, post-security passengers usually have less baggage. The reduction in baggage gives passengers additional alternatives in vertical conveyance choices and may reduce elevator use as a result.

2. Capacity

Elevator capacity depends on several different characteristics, including rated speed, number of stops, cab floor area, dwell times, and passenger demand patterns between levels of the building.

Cab size in an airport environment should be guided by several factors including the required system capacity measured in passengers per peak 15 minutes, specific use, area occupancies, and level of service to be achieved during the 15-minute peak period. Specific uses include janitorial and supplies services, concessions goods, airport employee, airline personnel, public, and traveling passenger conveyance. With respect to passenger conveyance, cab size should be guided by the typical area required by each standee with or without baggage, baggage carts, or wheelchairs. *Figure 43* indicates the typical area required by standees. Typical area occupancy is around 3.5 sf/person for a crowded elevator, not including baggage. With baggage, typical area occupancies may increase to 10 sf/person on average. Recommended cab size for elevators in airports ranges between 40 and 55 square feet, which allows for 4 to 5 persons with baggage, or up to 10-15 persons without baggage⁷¹.

⁷¹ ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 2.3.1.1

When intended for extensive use of passengers with baggage carts, cab configurations often have large door widths and flow-through door configurations (i.e., doors on each side of the cab). These large units are typically ordered as special-order hospital-size elevators with large cab sizes.

BAGGAGE HANDLING APPROACH	Diagram	TYPICAL AREA
NO BAGGAGE CARRIED BY PASSENGER		3.0 SQUARE FEET
CARRY-ON BAGGAGE CARRIED BY PASSENGER		4.0 SQUARE FEET
CHECKED BAGGAGE CARRIED BY PASSENGER		8.0 SQUARE FEET
BAGGAGE CART		12.0 SQUARE FEET

Figure 43: Typical Area Required for Standees⁷²

3. Elevator Boarding Area & Wait Time

The quality of elevator service is normally based on waiting time. Service time of 30 seconds and an average wait time of 1 minute are typical in an airport environment. The service time corresponds to the time it takes to board the elevator and includes door open time, boarding/deboarding time, time to push the elevator button, and door close time. The average wait time is the time a passenger waits for the elevator to arrive, prior to the start of the elevator service time. Boarding areas should provide

⁷² ACRP 67 Airport Passenger Conveyance Systems Planning Guidebook, Section 4.3.3.1

adequate space for queuing passengers. On average, 20 square feet per person (sfpp) should be provided at elevator queuing and boarding areas in an airport environment.

4. Consideration of Using Freight Elevator

For Luggage Processing Units, specially designed units are required for the acceptance of oversized or out-of-gauge (OOG) baggage. These must be located in clearly identified positions within the processing hall. These processing positions have wider baggage belts with a straight feed down to the outbound baggage hall. They usually also have access to a freight elevator or door that will allow large non-conveyable items (Super-OOG) to be placed on a cart and taken to the outbound baggage makeup hall⁷³.

f. Restrooms

Restrooms play an important role in airport facilities for passenger and staff convenience and passenger perceptions regarding their overall experience at an airport. Passengers and staff should be provided with adequate toilet facilities near all main waiting zones and workplaces.

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

Refer to Public Terminal Restrooms Appendix for the *PANYNJ Airport Planning Standards Guidelines for Public Terminal Restrooms*.

g. Concessions

Refer to Part 1, Section 4.

h. Meditation / Prayer / Quiet Room

Considerations should be given to providing quiet space facilities for passengers to rest, pray, or contemplate. Different religions have different facility requirements, these need to be considered carefully in conjunction with the relevant stakeholders during the planning process⁷⁴.

i. Facilities for Passengers/Employees with Disabilities (ADA and Universal Design)

1. Americans for Disabilities Act

Airports shall adhere to the design standards set forth by the Americans with Disabilities Act (ADA). Airport terminals should fully accommodate the needs of passengers with disabilities and provide respective facilities that offer the greatest possible traveling comfort to them. Terminal operator/designers should also provide suitable workplaces to employees with reduced mobility. The guiding principle for airport planners and designers is that persons with reduced mobility should be allowed to exercise self-reliance wherever possible⁷⁵.

⁷³ IATA Airport Development Reference Manual 10th Edition, Section 3.4.11.3.4

⁷⁴ IATA ADRM 10th Edition, Section 3.4.11.13.2, 2017

⁷⁵ IATA ADRM 10th Edition, Section 3.4.5, 2017

Whenever possible, terminal facilities should enable passengers with disabilities to use the same facilities as passengers who do not have reduced mobility. All elevators, concessions, and restrooms in the terminal building must accommodate wheelchair users to meet ADA requirements.

2. Universal Design (Inclusionary Design)

Universal Design integration aims to achieve an equal level of service and increase safe and efficient travel for people, of all ages and abilities, to the greatest extent possible, without any intended or unintended obstacles that limit, segregate, and stigmatize. There are two growing disability markets to serve that primarily include individuals born with disabilities or disabled as younger adults. The second market includes mature individuals with late onset disabilities. ACRP Report 130 and ACRP Report 157 summarize, "The intent of universal design is to create spaces and components that everyone can use, regardless of mobility, age, status in life, ... It is important to consider universal design, especially from the perspective of providing excellent customer service. With our increasing elderly population, for example, accommodation for limited mobility, visual and hearing impairments, and slower movement is no longer just the realm of the accessible." Planners may wish to refer to the FAA Airport Disability Compliance Program and the New York City Inclusive Design Guidelines.

j. Outdoor Waiting / Seating Areas

To comply with PA Policy and applicable state laws against smoking indoors, certain areas outdoors are designated for smoking. Smoking areas must be a certain distance away from entry doors and HVAC system intakes.

k. First Aid / Emergency

Medical facilities should be provided to staff and passengers for treatment of medical emergencies (first aid), for aircrew medical inspection and for emergencies and rescue. The usefulness and efficiency of any medical emergency and rescue organization on an airport may be greatly enhanced if it is in continuous use dealing with day-to-day medical activities during the normal routine working of the airport⁷⁶.

l. HVAC

Heating, Ventilation, and Air Conditioning (HVAC) are the systems used to provide thermal comfort and ventilation for the terminal building interiors. By providing proper thermal comfort in the terminal, passengers will experience a more pleasant building environment when moving throughout the building.

m. Lighting

Providing the proper lighting in the terminal building ensures passengers and employees can clearly see and find their way throughout the terminal, especially when looking for signage and specific amenities. Proper lighting also ensures a pleasant passenger experience.

⁷⁶ ICAO Doc 9184-AN/902, Airport Planning Manual Second Edition, Part 1, Section 12.3, 1987

n. Public Address / Visual Paging System

Public areas of a terminal and passenger airside facilities, including boarding lounges, should be provisioned with means for paging and mass notification. These systems need to be modular so they can be adapted to new or changing uses in different parts of the airport (passenger halls, retail areas, etc.) and controllable by zone according to the messaging function being performed⁷⁷.

o. Wayfinding & Signage

Signage and wayfinding is an important airport terminal component that facilitates the movement of departing passengers from the airport access roadway (or transit system) through the terminal to the departure lounge; and vice-versa for arriving passengers. However, passenger demographics are diverse, and can include frequent business travelers, first time travelers, international passengers, aging passengers and passengers with disabilities. Therefore, it is important that signage and wayfinding is consistent and reliable throughout the airport, and meets all local and national code compliance standards⁷⁸. All projects at port authority facilities must follow PANYNJ Pedestrian Signage and Wayfinding Standards.

p. Advertising

In-terminal advertising includes traditional static airport advertising displays such as wall posters, backlighted wall displays, wall wraps, and large-format displays.

Other advertising media in airports may include interior and exterior loading bridge wall wraps, ads on luggage cart panels, banners and column wraps, and dynamic displays including flat-panel monitors, video projection systems, and displays with alternating, changeable printed media. The development of light-emitting diode (LED) displays, such as those used as high-definition video walls in sports stadiums, is providing new opportunities to create free-form, custom displays capable of dynamic graphics and video⁷⁹. Advertising programs are subject to review and approval by PA customer service group.

q. Passenger Personal Technology Support

1. Electric Power Outlets

The recent trend, likely to increase in the foreseeable future, is that most passengers carry one or more electronic devices on a flight, including laptop computers, tablets, smartphones, e-readers, and gaming consoles. The convenience of recharging electronic devices at the airport adds to customer satisfaction, allowing passengers a way to stay connected and remain productive while traveling through the airport, as well as charging their devices before a flight which may not offer electric recharging on board.

Providing convenient electrical outlets is a trend that is increasing in popularity at airports and has more recently been recognized by some airlines as a potential LOS enhancement to be associated with their particular airline brand⁸⁰. When insufficient electric recharging is provided, passengers tend to cluster

⁷⁷ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 4.6, 2010

⁷⁸ FAA AC 150/5360-13A, Section 6.4.4, 2016 (Draft)

⁷⁹ ACRP Report 54, Resource Manual for Airport In-Terminal Concessions, Chapter 2, Section 2.2.5, 2011

⁸⁰ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.6, 2010

around the few available electric outlets, creating unwanted crowding, sitting on the floor, and competition for scarce resources, in hallways or other locations not intended for sitting or waiting.

The recharging outlets at the airport should be located primarily in holdrooms, because that is where passengers spend the most stationary time. Holdrooms shall provide a number of charging receptacles accessible to the public for no less than 50% of the seats available in the holdroom. At least one-half of the receptacles provided must be standard North American 110v outlets with 3-prong (grounded) plugs. USB recharging outlets are recommended in addition to standard outlets. Outlets of both types may be either incorporated into holdroom seating (as an original accessory, or a retrofit), or on standing stations or pylons furnished by a third-party provider (often a technology company), sometimes with advertising and/or charging a fee for use. Providing outlets at holdroom seating is the higher level of service.

2. Wi-Fi

Many airports have added free Wi-Fi high-speed Internet access as an amenity for travelers. Some offer Wi-Fi access throughout the entire airport, while others may limit access to specified areas of the terminal complex or waiting areas. In addition, many airline club lounges offer their own free or fee-based Wi-Fi access⁸¹.

8. Back-of-House Areas

Non-public support facilities comprise a wide variety of tenants and functions, such as employee amenities, operational spaces, and office space for agencies, including Port Authority, Federal Aviation Administration (FAA), Transportation Security Administration (TSA), US Customs and Border Protection (CBP), police, FBI, and Airport Rescue & Firefighting (ARFF). Airline and third-party ground handling contractor support facilities would be also included in this group.

The area provided in the airport for these facilities varies per airport, depending on different factors, such as which specific agencies would occupy the building, and operational layout issues such as the provision of secure vs. non-secure vs. sterile elevators to segregate passengers, staff, goods, and waste.

Considering all these factors, the typical area assigned to non-public supports facilities ranges from 12% to 16% of the total gross terminal building area. Terminal designers can use this number as a starting point for initial space planning exercises, but as soon as possible in the programming phase, actual space requirements should be assessed for each tenant and user.

a. Employee Screening

Employee screening is currently not a TSA mandate. Terminal operators or airlines may elect to screen employees via similar means that passengers are screened, (e.g., walkthrough metal detector and X-ray screening of bags / other possessions.) Employee screening is more commonly implemented at airports / terminals that have experienced some level of employee (“insider”) criminal activity. The TSA may eventually require all employees with airside access to be screened, and so some airports are reserving space for this purpose.

⁸¹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.6, 2010

It is recommended that the screening of staff be separated from other screening operations. Screening requirements for staff may differ to those applied to passengers. Additionally, combining the two flows and processes in the same area can be difficult to manage, particularly during peak periods⁸².

b. Airline Spaces

The following list discusses the various types of airline offices that should be considered for office space allocation⁸³:

- Airline Administrative Offices: Airline offices include the Airport (or Airline) Ticket Office (ATO) and other airline administrative spaces. The ATO is usually located immediately behind, or in proximity to, the check-in counter to provide support functions and supplies for the airline staff and equipment handling check-in and ticketing.
- Other offices may include space such as the airline station manager office or a sales office.
- Baggage Service Offices: Refer to Part 1, Section 5.
- Airline Operations Offices: Operations include all support spaces for aircraft servicing and aircraft crew-related support spaces, typically located on the apron level.

At airports with a large number of small domestic, international, and/or charter airlines, many of these carriers may use ground handling services provided by third parties. These third parties may include one or more ground handling companies, or other airlines. Typically, this use of third-party ground handling service providers will reduce the amount of operations space in a terminal; however, ground handler support space must still be provided elsewhere on the airport. It should be noted that some larger airlines will also use third parties at their smaller stations.

Hub airlines, in contrast, may require a significantly larger amount of operations space due to locating some functions at the hub airport that serve smaller spoke airports in the region. These support functions may include space for crew-based (flight deck and/or cabin staff) offices and lounges, aircraft parts storage, larger storage areas for passenger cabin stores, etc.

c. Concessions Storage

Concession storage is typically accommodated in a combination of storage space in or near the concession unit, if space is available, and storage space in lower levels of the terminal adjacent to the truck bays. Concession storage space near the truck bays will hold incoming products and inventory for restaurants and retail stores⁸⁴.

d. Port Authority Spaces

In addition to offices for airport staff, many airports have a communication / incident control center that can often double as a meeting room or for other functions that are required on a more day-to-day basis⁸⁵.

⁸² IATA ADRM 10th Edition, Section 3.4.11.12.3d, 2017

⁸³ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.11, 2010

⁸⁴ ACRP Report 54, Resource Manual for Airport In-Terminal Concessions, Chapter 11, Section 11.3, 2011

⁸⁵ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.14.3, 2010

e. Other Agencies' Offices and Support Spaces

Besides the TSA, Port Authority, and terminal operator, other agencies that may require tenant space in a terminal include various US Customs and Border Protection (CBP) divisions, police, and FAA. The requirements for these agencies vary by airport and terminal.

Although the TSA is responsible for screening passengers and their baggage, TSA officers do not have authority to arrest. For this, a local law enforcement officer (LEO) is required. Typically, there is space for an LEO at the SSCP, but depending on the size of the LEO presence at an airport and any additional duties (such as traffic enforcement), additional office and support spaces may be required⁸⁶.

In association with the baggage inspection control, customs may require offices for their administrative procedures, as well as for interview or search rooms for passengers found in contravention of regulations. Office accommodation for customs in this area should be restricted to the absolute minimum necessary for application of baggage inspection; supporting administrative offices, rest rooms, etc., should be provided elsewhere in the building⁸⁷.

f. Other Tenants' Offices and Support Spaces

Maintenance, janitorial, and storage space includes the building maintenance functions that are required to be within the terminal building. In addition to typical janitorial and supplies storage, areas may be required for hoists (cherry-pickers) and other specialized equipment needed to clean and maintain high-ceiling areas or certain types of window walls. Additional maintenance support may also be provided by facilities outside the terminal complex⁸⁸.

g. Ramp Control

The FAA airport traffic control tower (ATCT) does not typically take control of aircraft until they enter the movement area. At smaller airports with lower numbers of gates, aircraft can push back and otherwise maneuver on the terminal ramp with minimal control. At larger airports, especially with the potential for aircraft to simultaneously push back into the same taxiway area, a ramp control tower is typically required. This tower can be staffed by either the airport's operations department or an airline if it controls a large proportion of gates⁸⁹.

h. Vehicle Screening

Vehicles entering airside areas or parking within the terminal security perimeter must be screened to ensure against threats. The prevalence of trucks or other large vehicles bringing deliveries or bulk goods to terminals increases the overall security risks. Standard methods for vehicle screening involve visual inspections of the cargo compartment, inspection of a vehicle's underside with a mirror, and explosive-detecting dogs. Screening may be accomplished at the entrance to the airport or at individual terminal entrances, provided unscreened heavy goods vehicles are not able to access sensitive areas at any time

⁸⁶ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.14.4, 2010

⁸⁷ ICAO Doc 9184-AN/902, Airport Planning Manual Second Edition, Part 1, Section 9.5.19, 1987

⁸⁸ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.14.2, 2010

⁸⁹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.11, 2010

prior to screening. This screening area should be located at least 300' away from the terminal and with a guard post and control point.

With respect to vehicles, the NYPD recommends screening for High Tier buildings at direct entry points as well as at the entrances to underground parking areas and loading docks. Effective vehicle screening requires an adequate number of well-lit vehicle entrances to accommodate peak flows of vehicular traffic and to provide sufficient visibility of vehicles at the true perimeter. The NYPD recommends that security personnel at High Tier buildings ensure that vehicle access points are securely locked when not operational, illuminated during off-hours, and inspected periodically by a roving patrol. Additionally, barrier systems should be put in place to thwart any attempt to "rush" the checkpoint⁹⁰.

The NYPD recommends that owners of High Tier buildings provide for off-site screening of vehicles; when no such design is feasible, building owners should create hardened on-site areas sufficiently removed from critical facilities and occupied spaces. Because underground parking areas and loading docks may create significant vulnerabilities based on their proximity to the base of a building, owners of High Tier buildings should harden them as much as possible, and design them to both limit damage to adjacent areas and vent explosive forces outward.

i. Loading Docks

Receiving areas and loading docks can serve both terminal maintenance and concessions. It is generally recommended that loading docks should be provided for concession deliveries to avoid clogging the terminal curbs with delivery vehicles. When loading docks are used for concession receiving, provisions may need to be made for security screening of food and retail merchandise before it can be moved to a secure area of the terminal⁹¹.

j. Incoming Goods Screening

Any goods entering in the airport are subject to x-ray screening before been accepted for storage.

Security screening checkpoints may be located at the airport security perimeter, at the truck bays to screen inbound concession goods, or further downstream in the terminal building. To best accommodate the size of typical loads associated with terminal retail products, an oversized x-ray machine is required⁹².

k. Trash and Recycling

Trash compactors are also typically co-located with loading docks, and multiple compactors may be required depending on the volume and types of trash generated in the terminal⁹³.

⁹⁰ NYPD Engineering Security Protective Design for High Risk Buildings, Chapter 5: Guidelines on Access Control, Screening & Monitoring, 2009

⁹¹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.14.3, 2010

⁹² ACRP Report 54, Resource Manual for Airport In-Terminal Concessions, Chapter 11, Section 11.1.3, 2011

⁹³ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.14.3, 2010

l. Building Services (MEP)

This area of the plan includes all the utility support areas for the terminal and concourses. Recent trends in computer systems, telecommunications, and other building-related systems have increased the demand for these areas within the terminal building. Some of these areas can be accommodated in the airline operations area whereas common-use systems need to be located in the airport-controlled areas. Plumbing is also a difficult system to remove and or relocate within a terminal facility. Thus, areas such as restrooms should be located in areas that are less likely to require future relocation if possible⁹⁴.

m. Flood Control Resiliency

Flooding occurs when normally dry land becomes inundated with water. Sources of the water may be the result of natural bodies of water overflowing their banks, rapid accumulation of runoff or surface water, hurricane-caused storm surges or earthquake-caused tsunamis, or erosion of a shoreline. The following are recommendations gathered from best practices in dealing with storm effects at other major US airports.

1. Reference Documents

- *FAA AC 150/5200-31C – Airport Emergency Plan*
- *FAA AC 150/5210-22 - Airport Certification Manual (ACM)*
- *ACRP Report 65 - Guidebook for Airport Irregular Operations (IROPS) Contingency Planning*
- *ACRP Report 81 - Winter Design Storm Factor Determination for Airports*
- *ACRP Report 93 - Operational and Business Continuity Planning for Prolonged Airport Disruptions*
- *ACRP Report 112 - Airport Terminal Incident Response Planning*
- *ACRP Report 123 - A Guidebook for Airport Winter Operations*
- *ACRP Report 147 - Climate Change Adaptation Planning: Risk Assessment for Airports*
- *ACRP Report 160 - Addressing Significant Weather Impacts on Airports*

2. Communications

PANYNJ shall conduct a daily general briefing of airport operations officials with representatives of airlines and a roster of state and federal agencies to share information that might affect that day's airport operations: everything from the weather to runway maintenance. PANYNJ should serve as the ultimate authority with the lead PANYNJ director leading the meetings. Each of the terminal operators at each respective airport should have its own manager who reports to the lead PANYNJ director.

After the general meeting, an additional severe weather forecast briefing (if needed) and Crisis Management meeting should be conducted to review detailed weather report and communicate with the airlines about status of their flights. A significant component of the Crisis Management meeting involves understanding how airline partners are planning for severe weather events. The airports should

⁹⁴ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.14.1, 2010

have an established plan that outlines planning priorities, which is dynamic to accommodate information from airlines, the FAA, the National Weather Service (NWS), and others stake holders.

Each Crisis Management meeting should arrive at an agreed airport status. (e.g., terminals must operate up until 12 hours before storm hits) that all parties would work to and start mobilizing their responsibilities. Crisis Management meetings should include a detailed review of the resources available to all affected parties, and assessment made of the ability of the contingency plan to be delivered. To support this, PANYNJ and airport partners should have a joint, pre-arranged plan for deploying their staff resources in the quantities required for threshold conditions that would trigger the cancellation or postponement of flights.

Each Crisis Management meeting should end with an agreed summary of actions which should be shared amongst participants.

- This provides time for the airlines to cancel flights and communicate with passengers when the final flights will be departing, reducing the number of people at the airport by the time the storm hits. At that point, the airport starts securing movable items, setting up temporary flood barriers, tying down outside equipment, ensuring generators are safe and operational, and sending out final flights.
- Staffing for a storm should have two teams of staff switch back and forth on 12-hour shifts. The severe weather event requires ride-out teams and recovery teams. The ride-out teams are expected to arrive on-site prior to a flood event occurring and should be prepared to stay through the duration of the event until relieved by recovery team(s). The recovery teams are expected to arrive on-site as soon as is reasonably practicable following a flood event occurring and should be prepared to address immediate recovery activities on-site, such as removal of excess water, clean-up, and restoration of airport operations.
- Staff are notified of which group they are in ahead of time to give them time to handle any needs at home before coming into work. Additionally, the airport provides food, fuel, showers, and places to sleep for staff providing their services during events. Staff are encouraged to bring other amenities they might need to be comfortable to ensure that they can be ready and able to work when their shift begins.
 - Supply food and potable water, stored on site, for each employee and passenger stationed at the airport for at minimum 3 days after the flood.
 - All parties should be suitably represented at Crisis Management meetings and should ensure their representatives are fully informed.
 - The Airport's Crisis Management rostering should ensure that there is always available a member of the airport executive management team, with extensive, significant and relevant operational experience; and the PANYNJ director should seek to establish contact with their equivalents in key external stakeholders impacted by a crisis.

3. Operational Procedures

This section contains a listing of the functional annexes that would be required in the preparation of a hazard-specific appendix for floods. It also identifies the unique and/or regulatory planning considerations that should be used by the Airport Emergency Plan (AEP) planning team.

i. Direction and Control.

The extent of the initial response will depend on warning time, which varies with the cause and the source of the flooding. Intense storms may produce a flood in a few hours or even minutes for upstream

locations, while areas downstream may have from 12 hours to several weeks to prepare. Flash floods occur within six hours of the beginning of heavy rainfall. The AEPs of airports downstream of a heavy flood source should, in coordination with the local emergency management agencies' Emergency Operations Plan (EOPs), address the following planning considerations in one or more appendices to a Direction and Control Annex:

ii. Flood Control

Preparation to control flooding should include:

1. Coordination with AEP planning staff during disaster or disaster threat situations to facilitate expeditious notifications and exchange of information.
2. Mapping of areas likely to be flooded.
3. Identification of potential locations for the placement of temporary flood defenses and the inclusion of this information on the appropriate maps.
4. Arrangements for a labor force to perform flood fighting tasks associated with building a flood defense (i.e., fill and place sand bags to prevent flooding).
5. Temporary flood defenses should be completely deployed 4 hours prior to a heavy rainfall event, 6 hours prior to a potential flash flood event, and 12 hours prior to a hurricane event. It will be up to the terminal operator to decide how to meet these deployment requirements (i.e., amount of labor needed, storage locations for the flood defenses, duration required to deploy, etc.).
6. Temporary flood defenses should be completely deployed 4 hours prior to a heavy rainfall event, 6 hours prior to a potential flash flood event, and 12 hours prior to a hurricane event. It will be up to the terminal operator to decide how to meet these deployment requirements (i.e., amount of labor needed, storage locations for the flood defenses, duration required to deploy, etc.).
7. While there are several types of flood defenses, it is up to the terminal operator to decide how the flood defenses will maintain critical building systems and defer others not deemed critical to terminal operations.
8. A Hurricane Response Schedule shall follow an earlier set of emergency response actions for hurricane response. The schedule establishes phases for the approaching hurricane, describes the activities to be completed during each phase, and establishes some priorities for actions to be taken.

iii. Continuity of Operations

Address the relocation, as necessary, of key operations, resources, vital records, and equipment to assure continuation of services and to prevent damage and loss.

Passenger and aircraft operations of the terminal shall terminate with the initiation of flood mitigation measures as described above, because the mitigation elements will physically interfere with normal circulation.

iv. Before the Event

Develop a facility inspection Standard Operational Procedures (SOP) that is specific to potential flood damage. This is something that can be used by terminal employees as a preparatory inspection process, such as checking and testing flood pumps, checking levees and dikes, inspecting flood control devices, etc.

Develop a list of terminal facilities which are in low lying areas and potentially subject to flooding, including the any electrical equipment, access points (doors, windows, garbage chutes, BHS/ventilation openings, underground facilities, etc.). The equipment and systems listed in Table 5 are considered critical and shall be considered for priority for floodproofing.

Terminal operators must hold twice-annual on- and off-season flood-specific training programs, deployment drills, and operational exercises. This ensures that new and current employees are up to date with any operational procedures that may have changed from the previous training.

Check the availability of emergency generators to maintain the operation of critical terminal facilities during and after the event.

System	Critical Equipment/Systems
Electrical	Substations, Transformers, Switchgear, Service and Distribution Panels, Emergency Panels, Cable Terminations and Splices, Emergency Generators, Stock and Parts Storage, Meter Centers
Water and Plumbing	Domestic/Fire Water Pumps and Controls, Sump Pump Non-Submersible Motors and Controls, Plumbing Systems (lavatories, showers, toilets), Ejector and Grinder Pumps, Water Heaters, Pipe Insulation
Mechanical	Air Intake and Exhaust Vents/Louvers, Air Conditioning Units and Condensers, Chilled Water Systems, Pumps, Ventilation Units, Boilers, Unit Heaters, Distribution Duct Work
Telecommunications	Telephone Switches, Network Interface Devices, IDF Closets, Data/Computer Centers/Rooms, Dispatch Rooms, Emergency Communications Centers, Public Announcement System Control Rooms, Radio Systems (incl. personal radio storage areas), Surveillance Systems, Access Control Systems
Emergency and Fire	Fire Alarm Master Boxes, Emergency Operations Centers, Emergency Supplies (medical, food/water, cots/blankets), Emergency Vehicles and Specialized Equipment (medical, fire, rescue, law enforcement)
Hazardous Materials	Waste Oil, Fuel Storage Tanks, Chemical Supplies
Other*	Records Storage, Office Space, Parking Garages

* Floodproofing recommended but not required for tenants and third party leases/developments.

Table 5. Critical Infrastructure Subject to Immediate Floodproofing Standards⁹⁵

⁹⁵ Massachusetts Port Authority - Floodproofing Design Guide

v. After the Event (Recovery)

The recovery effort will be dependent upon the severity of the flooding; the amount of damage; facilities, equipment, and systems impacted; and the availability of resources. Recovery efforts should involve:

- Arrangements for a labor force to dissemble the temporary flood defenses when suitable (i.e., when water levels reach a certain point where it would not leak into areas the flood defense is preventing water from entering).
- As with other emergencies, consider the formation of a Situation Analysis Team consisting of representatives from appropriate airport organizations, functional areas, tenants, etc., that:
 - Ensures periodic damage assessments are conducted.
 - Prepares an Incident Action Plan, to include long- and short-term considerations for:
 - Final damage assessment (written, pictorial, including video).
 - Safety issues (e.g., downed power lines, unsafe drinking water, etc.).
 - Sanitary issues.
 - Public information announcements.
 - Facility repair.
 - Supply inventory and restoration.
 - Cost documentation.
 - Economic impact.
 - Documentation of actions taken.
 - Personnel utilization by time on duty.
 - Critical Incident Stress Debriefing requirements.
 - Equipment utilization documentation.
 - Overall cleanup activities.
 - Air Operations Area (AOA) inspections.
- Issuance appropriate Notices to Airmen (NOTAMs).
- Critique of the overall operation and apply lessons learned to planning and training programs.

4. Temporary Flood Defenses

Given the dynamics of global climate change and the costs of designing for a worst-case scenario, it is generally accepted in the industry that complete flood-proofing of airports is not feasible. Therefore, many airport operators seek to increase the resilience level of the airport to flooding and other disasters, ensuring rapid recovery and restoration of services.

Temporary flood barriers are systems that are brought to a site to provide a flood defense for a limited period. They are then removed until required again. They have no fixed foundation other than the natural ground on which they are based (with perhaps minor modifications to ensure proper stability or performance of the temporary barriers). No type of temporary barrier is universally deployable in all situations, and generally they cannot withstand large wave action. All leak to a certain extent and therefore need to be accompanied by pumps.

5. PANYNJ Review and Proposals

The terminal developer must submit an emergency and flood operations plan to the Port Authority for review and approval that shows how the terminal operator will respond before, during and after the disaster event. Table 6 describes the requirements of the floodproofing design process. This process shall be followed for new construction and additions, substantial repair or improvement projects, or dedicated floodproofing projects. The intent of this process is to identify floodproofing-related issues early in the design process to ensure that the proposed floodproofing strategies to be used are adequate and that operational, maintenance and storage requirements are clearly understood by all parties responsible for implementing them.

Design Stage	Design Flood Parameters and Calculations	Floodproofing Design Narrative and Drawings	Floodproofing Calculations	Flood Operations Plan	Floodproofing Inspection and Maintenance Plan
Schematic Design/ Pre-Design	Identify FEMA Flood Insurance Rate Map (FIRM) information and PANYNJ DFE ⁹⁶	Identify proposed strategies and performance objectives to be achieved by design	Conduct facility condition assessment and/or site assessment	Identify parties responsible for facility flood emergency response	Identify parties responsible for facility inspection and maintenance
30% Design	Preliminary design load assumptions and calculations	Identifies specific measures to achieve performance objectives; Review for code compliance, update narrative	Engineering report with structural calculations demonstrating floodproofed facility can withstand design loads	Outreach to parties responsible for implementing active floodproofing measures; Prepare draft plan	Outreach to parties responsible for inspection and maintenance of floodproofing measures; Prepare draft plan
90% Design	Update	Update narrative and drawings	Update structural calculations	Update draft plan	Update draft plan
Final Design	Finalize	Finalize narrative and drawings. Complete FEMA NFIP floodproofing certificate for non-residential structures signed/ submitted. For new construction with lowest floor elevated above base floor elevation or DFE, complete FEMA NFIP elevation certificate, signed and submitted	Finalize	Final plan and approval memo	Final plan and approval memo

Table 6: Floodproofing Design Implementation Process⁹⁷

⁹⁶ The design flood elevation (DFE) corresponds to the maximum level of water that an engineered structure has been designed to resist, being a foundational input for the calculation of design flood loads, which then set the parameters for structural design. DFEs are also used as a vertical threshold above which the lowest floor of the lowest enclosed area, important utilities, life safety systems, and other critical equipment must be elevated. If elevation above the DFE is not feasible, floodproofing critical areas below the DFE may be permitted. The DFE will be defined by the maximum water elevation with a 0.2% annual probability of exceedance in 2030 plus 3 feet of freeboard. This translates to an elevation of 13.7 feet for existing terminal facilities and 17.0 feet for new terminal facilities.

⁹⁷ Massachusetts Port Authority - Floodproofing Design Guide

n. Triturator

At the end of each flight, the aircraft restroom wastewater or “blue water” is vacuumed into tanker trucks to be disposed in sewage treatment. Experience has shown that this wastewater often contains objects that are accidentally or intentionally flushed by passengers, which are not acceptable for local sewage treatment facilities. Therefore, from the tanker truck, the entire contents must pass through a special grinder known as a triturator, which grinds the contents into small enough pieces that can safely enter the sewage treatment facility.

o. IT/Communications Rooms and Facilities

IT design in the terminal is no longer limited to point-to-point copper wire connections; the immense opportunities available in fiber optics and computerized local area network/wide area network (LAN/WAN) implementation can now be optimized by the early inclusion of IT professionals in the planning and design process⁹⁸.

In addition to security, specifications for networked terminal facilities should address requirements for bandwidth (wired and wireless), availability, uninterruptible power supply (UPS), and emergency power backup.

⁹⁸ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 4.2, 2010

Part 2 - Planning and Design Methodology

1. Scope

The objective of this section is to support the planning and design team in identifying the optimal requirements for the terminal facilities (key rooms, areas, processing elements, etc.), to supplement the forecast and proposed airside design. The planning and design process entails collecting data and information on existing conditions as well as airport specific passenger behavioral characteristics (see Section 3). This information must be analyzed with appropriate demand levels for various terminal functionalities. The demand levels are derived from forecast, the Design Day Flight Schedules (DDFS) and other parameters (see Section 4).

The terminal building shall be designed in accordance with the following codes and standards found in Section 2 below.

All terminal facilities should be planned to achieve the level of service defined in the sections below in order to ensure a terminal design that provides high level comfortable and seamless passenger experience. Section 5 presents the Port Authority's standard methodology and criteria for planning to be followed by developers and planners when designing passenger and baggage processes inside a terminal building. Port Authority's standards are based on the latest IATA ADRM guidelines, except for international immigration. For that particular element of the terminal, appropriate references to planning documents published by U.S. Customs and Border Protection (CBP) are provided in Section 5.

In addition to the analytical methodology presented in the following sections, the Port Authority recommends that simulation of the entire passenger processing environment within the terminal building (departure, arrival and transfer flows) is performed at a planning/design stage, in order to confirm the appropriate program requirements. Simulation analysis should be used to identify potential bottlenecks and crossflows, as well as to assess additional design and layout specific issues that may not be reflected in the analytical method. However, simulation results shall not be used to reduce capacity and space requirements calculated through the analytical method described in this document.

2. References

- a. Federal Aviation Administration (FAA) Advisory Circulars (AC) and Orders
 1. AC 150/5220-21C: Aircraft Boarding Equipment
 2. AC 150/5300-13A: Airport Design
 3. AC 150/5360-13: Planning and Design Guidelines for Airport Terminal Facilities
 4. FAA Federal Aviation Regulations Part 107 – airport security
 5. FAA – Federal Aviation Regulations (FARS 14 CFR)
 6. Applicable FAA Advisory Circulars
- b. Airport Cooperative Research Program (ACRP)
 1. ACRP Report 25, Volume 1: Airport Passenger Terminal Planning and Design
 2. ACRP Report 96 - Apron Planning and Design
 3. ACRP Report 161 - Guidelines for Improving Airport Services for International Customers

- c. International Civil Aviation Organization (ICAO)
 - 1. ICAO Aerodrome Design Manual
 - 2. ICAO Annex 14, Volume I: Aerodrome Design and Operations
- d. International Air Transport Association (IATA)
 - 1. IATA Airport Development Reference Manual
- e. Port Authority of New York and New Jersey (PANYNJ) Standards
 - 1. PANYNJ Engineering Department Civil Design Guidelines
 - 2. PANYNJ Standards and Guidelines for Port Authority Technology
 - 3. PANYNJ Sustainable Design Building Guidelines, August 15, 2007
 - 4. PANYNJ Sustainable Infrastructure Guidelines, March 23, 2011
 - 5. PANYNJ Tenant Alteration Procedures and Standards Guide, December 20, 2013
 - 6. PANYNJ Tenant Construction Review Manual
 - 7. PANYNJ Pedestrian Signing & Wayfinding
 - 8. PANYNJ Traffic Engineering Design Guidelines
 - 9. PANYNJ Traffic Signal Design and Drawing Preparation Guidelines
- f. Transportation Security Administration (TSA)
 - 1. Planning Guidelines and Design Standards for Checked Baggage Inspection Systems (PGDS), Version 5.0 (2015)
 - 2. Checkpoint Design Guide, Revision 5.1 (2014)
- g. Airports Council International (ACI)
 - 1. Apron Markings and Signs Handbook, Third Edition, 2017
- h. United States Customs and Border Protection
 - 1. Airport Technical Design Standards (2017)
- i. National Safe Skies Alliance
 - 1. PARAS 0004 - Recommended Security Guidelines for Airport Planning, Design, and Construction 2017
- j. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO: A Policy on Geometric Design of Highways and Streets
 - 2. AASHTO: Roadside Design Guide
- k. American Society of Mechanical Engineers (ASME)
 - 1. ASME A17.1: Safety Code for Elevators and Escalators
 - 2. ASME B20.1 Safety Standards for Conveyors and Related Equipment and all addenda

- l. Americans with Disabilities Act (ADA), 2012 (or latest)
 - 1. Title III (28 CFR Part 36) ADA – ADOPTED July 1, 1994 (Updated September 15, 2010)
 - 2. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
 - i. ADAAG published in 28 CFR Part 36 Federal Register
 - ii. ADAAG for Titles I (Employees) and III (Public Accommodation)
- m. Architectural & Transportation Barriers Compliance Board (ATBCB)
- n. BOCA National Building Code
- o. Green Building Council (USGBC)
 - 1. Leadership in Energy and Environmental Design (LEED) New Construction Version 4.0
- p. Highway Capacity Manual (2010)
- q. Illumination Engineering Society of North America (IESNA)
 - 1. IES Handbook 10th Ed.
 - 2. IES RP-8-00 Roadway Lighting
- r. International Building Code (IBC)
- s. International Fire Code (IFC), 2010
- t. National Fire Protection Association (NFPA)
 - 1. NFPA 101: Life Safety Code, 2006
 - 2. NFPA 407: Standard for Aircraft Fuel Servicing
 - 3. NFPA 415: Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways
- u. Occupational Safety and Health Administration (OSHA)
- v. Earthquake provisions as required by local code
- w. All applicable federal, state and local codes

The following codes are applicable to projects in New York City only:

- a. New York City Building Code (NYC BC)
- b. New York City Fire Code (NYCFC), 2008
- c. NYSDEC SWPPP (6YNCRR-750)
- d. NYSDEC Storm Water Management Design Manual

The following codes are applicable to projects in New York State only:

- a. New York State Department of Transportation
- b. NYSDOT Highway Design Manual (HDM)
- c. New York State SWPPP (6YNCRR-750)
- d. New York State Storm Water Management Design Manual

The following codes are applicable to projects in the State of New Jersey only:

- a. International Building Code (IBC), New Jersey edition, 2009, or latest adopted edition
- b. International Fire Code, (IFC) New Jersey Edition 2006
- c. New Jersey Uniform Fire Code NJAC 5:70

3. Data Collection Program

Refer to Demand Section 4.

4. Assessing Passengers Demand

The methodology for assessing the passenger demand to guide the terminal design should be based on a combination of the design MAAP and the Design Day Flight Schedule (DDFS). The methodology for assessing the MAAP and preparing the DDFS is as described in Section I – Demand. These demand levels are then adjusted to reflect parameters including, but not limited to, passenger arrival curves at the frontage, upstream processing rates, downstream processing rate etc.

5. Planning Considerations and Conceptual Design Criteria

- a. Automated Processors

Airports and airlines are increasingly incorporating new types of passenger processing technology, resulting in a passenger experience that is more personalized. These technologies usually result in less overall processing and wait times and require less time per passenger from airline staff.

- b. Use of Technology

Technological advances have been changing the travel experience. As increasingly empowered passengers seek new ways to take control of and customize their own travel experiences, airports, often working in collaboration with airlines, have embraced intelligent innovations. Technology and constant innovation are shaping air travel as we know it. A few of the growing list of technology objectives and uses that are enabling the transformation of the airport experience and influencing customer satisfaction are discussed in the following.

1. Improve airport efficiency.

Self-service technologies such as online check-in; mobile boarding passes; self-tagging of baggage and bag drop; radio-frequency identification (RFID) bag tags; automated gates; automated passport control (APC) kiosks, the Automated Passport smartphone app; clearing security using technology and biometrics; and common-use technology could maximize the use of airport terminal space and provide flexibility to serve passengers.

2. Ease navigation

Dynamic signage and digital wayfinding; flight information displays (FIDS) and baggage information displays (BIDS); mobile apps; airport websites; and Global Positioning System (GPS) technology that communicate directions via the customer's smart phones; and operational alerts indicating delays and congestion along the customer's way.

3. Reduce waiting times

Using technology to monitor waiting times and length of queues, that alerts management to open additional stations when wait time standards are approached; advising customers of waiting time at the queues; notifying passengers of checkpoints with the shortest queues; enabling passengers to make reservations online to clear the security checkpoint; and using biometric data to expedite processing.

4. Provide flight, baggage, concessions, and other information

Automated airport alerts, airport apps, and social media; digital wayfinding; website and social media promotions; virtual assistants; remote customer service representatives using robotics or interactive kiosks; and customer relationship management systems.

5. Facilitate terminal planning and operations

Passenger flow applications and automated dashboards.

6. Solicit customer feedback

Engaging in a two-way dialogue with customers through social media, websites, and customer relationship management systems.

7. Streamline and simplify the customer experience

Apps to order food online that is delivered to the gate or picked up in the terminal to take on the plane; and automated parking assistance, including entry and payment options as well as online parking reservations.⁹⁹

c. Planning considerations for some processors that will move from manned to automated systems

1. Check-in processors: traditional check-in, baggage drop-off and self-service kiosks

New technologies can improve managing existing terminal capacity and expansion without building more infrastructure. Current trends in the check-in process are moving from traditionally staffed to more self-service counters and remote online check-in.

Self-service counters and other forms of electronic check-in (whether via Internet, off-site locations, mobile devices, etc.) have effects on the size and configuration of the check-in lobby. When planning the ticket lobby processing elements and spaces, designers should consult with constituent airlines to assess their current and future plans for passenger processing, and the check-in and bag check processing mode splits they expect passengers to utilize.

Based on the processing mode splits, the designer should calculate requirements for each type of processing element. In some cases, although airline staffing levels generally decrease, the ticket lobby area requirements could increase with additional technology. Proposals to provide relatively less

⁹⁹ ACRP Report 157, Improving the Airport Customer Experience, Chapter III, Section 3.4.6, 2016

processing infrastructure at the terminal due to high utilization of remote check-in, must provide definitive evidence of high levels of remote check-in, to be acceptable to the PANYNJ.

Technological advances in the check-in process can also have potential capacity effects on down-stream processes such as security, if the amount of time required for earlier processes is reduced and passengers find that they can show up at the terminal closer to departure time. Showing up later at the airport but processing more quickly through the check-in process places a more peaked demand on the down-stream processes such as security screening¹⁰⁰.

New apps are available providing remote baggage check as a premium service, where passengers will be able to choose with the phone, tablet, etc. the time slot for the airline or third-party baggage handling company to collect baggage to be checked at their house or hotel on the day of, or one day before travel, to the airport, transporting the baggage as an agent of the airline. This process is expected to be limited to a relatively small number of premium passengers willing to pay the extra fees, and therefore should not factor into any reduction in baggage system infrastructure at the terminal.

Remote check-in and bag check at major downtown transit centers is provided in some international cities. Downtown remote check-in solutions could address capacity constraints in terminals, improve passenger experience, improve accessibility and mobility, and encourage public transport usage, improving air quality.¹⁰¹ If downtown check-in and bag check are ever provided at a large scale at the Port Authority airports, that could provide a legitimate reason to allow a reduction in check-in and bag check facilities at the airports, in amounts to be determined.

2. Boarding pass and ID check before security screening

For centralized security facilities, IATA recommends boarding pass check facilities be designed based on fully automated self-service access gates or equivalent technology to reduce the number of manual processes required throughout the passenger journey¹⁰².

In the 2017 Checkpoint Innovation Supplemental Guidelines, TSA has indicated that Travel Document Check (TDC) can be replaced with Biometric Authentication Technology (BAT) electronic gates in the near future.

Automated access gates can be combined with a manned access gate for passengers needing assistance. The following aspects need to be considered for a manned access gate: additional floor space; a swinging or sliding door accessible for wheelchairs; and a sterile area exit for passengers wanting to go back landside. As with other technologies, the result of implementation of this system is likely to be a moderate increase in required area, along with a decrease in staffing.

¹⁰⁰ ACRP Report 25, Airport Passenger Terminal and Design, Volume I, Appendix G, Issues and Trends

¹⁰¹ City Check-In as Future of UK Aviation Design, Opinion Piece March 2018, Airportr.

¹⁰² IATA ADRM 10th Edit, Section 3.4.11.15

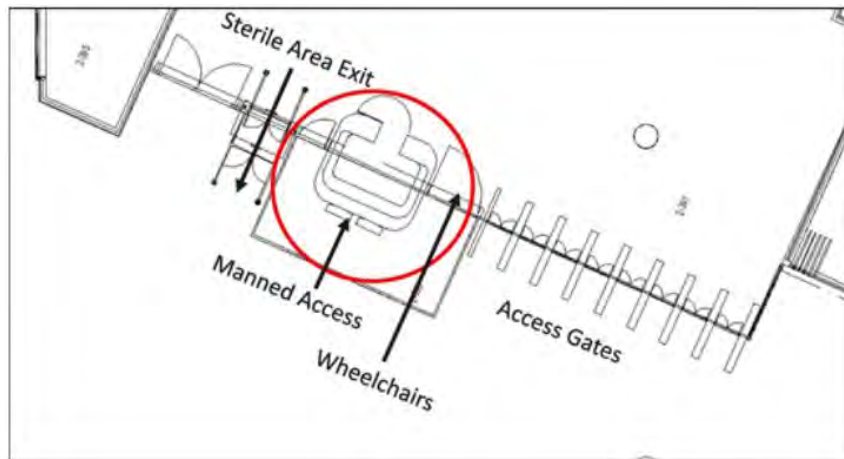


Figure 44: Combination of Automatic Access Gates and Manned Gates¹⁰³

3. Security screening

New security screening checkpoints are incorporating automated screening lanes and automated tray return systems. Automated tray return systems are recommended where possible, to reduce manual handling (by both staff and passengers) and to ensure a constant supply of trays to the passengers. While this facilitates enhanced overall productivity and increased passenger satisfaction, tray return systems occupy more space than conventional X-ray roller beds and also require additional technical support.

4. Immigration

Automated Immigration / Border Clearance solutions can reduce the overall space needed to perform this function. New technologies such as machine-readable passports, biometric data capture and processing as well as the resultant database links and encryption requirements are now being implemented around the world as more stringent immigration checks are required. Terminal planners should give consideration to the growing demand these technologies place on the airport IT systems.¹⁰⁴ While the primary screening (Immigration) area may decrease with the expedited process, the secondary screening (Customs) area will likely need to increase due to additional processing and queuing. Terminal designers should consult with the US Customs and Border Protection for current screening protocols and design guidelines.

d. Passenger Check-in and Bag Check - Methodology

Passenger 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

¹⁰³ ADRM 10th Edition

¹⁰⁴ ADRM 10th Edition, Section 3.4.13.2.3, 2017

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.

The program of requirements at a minimum, should identify and account for the following parameters:

- Counter operations and rules for use (counter availability and close-out time, use/lease basis, check-in options)
- Processing rates
- Passenger check-in options and class of service
- Planning schedule analyses by airline
- 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 (time and space)

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.

1. Off-site check-in

Guidance on design of off-site check-in and bag check is not provided here, because it is by definition not part of the airport terminal site. However, there are limits to the reduction of on-site check-in and bag check facilities provided in the terminal that may be assumed when accounting for off-site check-in as a percentage of the total peak departure demand for requirements analysis purposes.

If terminal designers wish to reduce on-airport check-in and/or baggage check facility requirements based on an assumption that a substantial portion of the peak-hour passengers would be checking in and/or checking bags off-site, the proposed percentage reduction should be submitted to the Port Authority for review and approval before starting any analysis.

2. Curbside Counters

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. These guidelines relate to:

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

Dimensional guidelines for curbside check-in, as well as ADA and FEMA bollards design guidelines, are illustrated below.

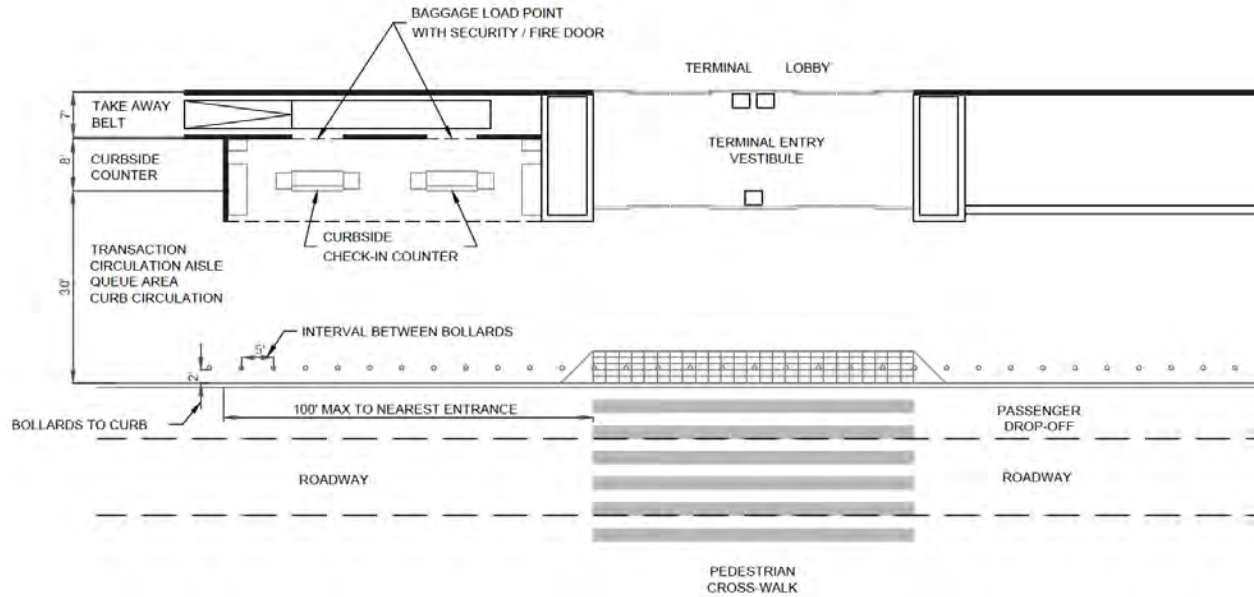


Figure 45: Minimum PA Standards for Terminal Frontage and Curbside Counters ¹⁰⁵

The following layouts depict PA minimum standards for other typical configurations of curbside counters:

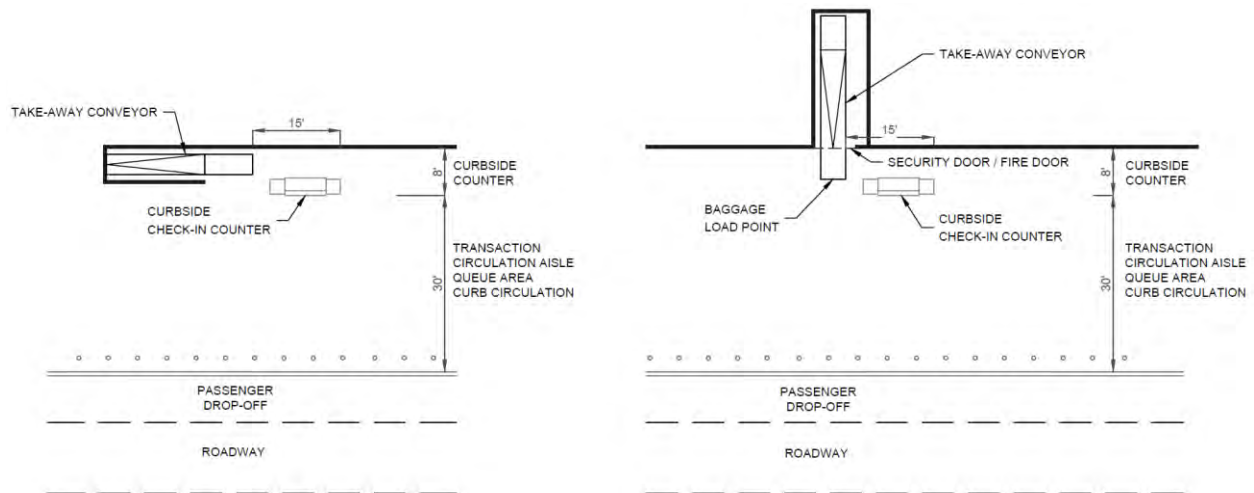


Figure 46: Minimum PA Standards for other configurations of Curbside Counters ¹⁰⁶

¹⁰⁵ Source: Port Authority of New York and New Jersey

¹⁰⁶ Source: Port Authority of New York and New Jersey

3. Departures / Check-in Hall

To develop check-in hall space requirements, key information is required in order to make accurate assessments. Each airport and airline situation is different, but there are common variables which influence spatial requirements for the check-in hall¹⁰⁷.

- Airport environment – are check-in hall facilities (ticket counters or kiosks) for common use or preferential use; is there a single dominant hub airline or are there multiple airlines?
- Patrons and passengers – factors such as the ratio between originating and connecting passengers, the characteristics and requirements of passengers who check-in and drop-off baggage (e.g., elite airline passengers or passengers requiring assistance, the number of well-wishers who see passengers off, earliness arrival profiles, etc.).
- Processing rates objectives – acceptable processing rates, allowable wait times, maximum queuing lengths, etc. to meet established level of service parameters; objectives need to be balanced against facility and equipment capacities.
- Airline processes – the unique characteristics, equipment, processes, and special requirements of individual airline check-in and bag-drop policies.
- Passenger volumes – estimated passenger volumes, typically expressed in peak hour numbers, based on forecasted activity levels.

When designing the overall area and configuration of the departures hall, the designer must provide the required number of passenger processing elements (kiosks, bag drops, counters, etc.) within a reasonably sized space with adequate circulation and emergency egress. The frontage of the building must provide adequate length and doorways to interface with the departures curbside. Immediately inside the doorways, adequate space must be provided between doorways and fixed objects or queuing zones, to provide visual access for intuitive wayfinding to check-in areas, and cross-circulation.

Working within the constraints of available width and depth of the terminal building site, the designer should configure the kiosks, ticket counters, and bag drops in the departures hall in such a manner that different types of passengers using different modes can find and access each mode easily and without getting in each other's way; usually with 20 feet circulation space between built elements and/or queuing zones. When ticket counters are configured in parallel "islands" arranged perpendicular to the front wall, clear distance between counters should be calculated, to allow for minimum 8-foot transaction / circulation aisle, adequate queuing zones based on demand in front of each counter, and 25 feet minimum clear circulation between queuing zones. More space is generally needed when serving international flights where passengers tend to have more, and larger, checked bags.

The walls and fixed elements of the departures hall should be configured so that the passenger's overall circulation path from curbside, through various check-in and bag check modes, and to the security screening checkpoint (SSCP) will be as direct and intuitive as possible, with minimal back-tracking or cross-circulation.

¹⁰⁷ FAA AC 150/5360-13A, Section 6.4.1, 2016 (Draft)

4. Check-in Counters - Processing Elements Calculation

The type and number of counter positions required are usually determined in consultation with each airline or handling agency according to its staffing criteria and company standards for processing passengers and baggage. Individual airport variables that influence the number of positions include one or more of the following¹⁰⁸:

- Design hour enplanements.
- Contact ratio
- Passenger arrival distribution patterns
- Average process time for each type of counter activity.
- Service goals of an individual airline for specific types of counter positions.

The required footprint for initial processing (check-in) facilities and associated queuing areas depends on their geometrical configuration. Queuing patterns will usually follow the airline's service frontage area. The depth of the queue depends on the waiting time policy and queue management strategy.¹⁰⁹

Sizing of the passenger processing hall depends on the number of passengers using the facility during the peak period, the proportion of premium passengers, the processing rate, the space provision per person as well as the maximum queuing time.¹¹⁰

The Port Authority requires that the number of required processors be calculated based on the maximum waiting times provided in Table 6. For the calculation of waiting area requirement, sufficient area to accommodate passengers' waiting time of 30 minutes must be provided, regardless of the target maximum waiting time.

All assumptions related to the percentages of passengers using a specific check-in mode must be documented and approved by the Port Authority. In addition, certain processors may be used by airport employees and must therefore be designed to accommodate that additional demand.

The Port Authority requires the use of IATA ADRM 10 methodology, taking into account the additional requirements stated above and in Table 6, for the calculation of number of processors, waiting areas, and total areas.

Flexible designs that allow for the future expansion of certain functions and contraction of others are necessary to ensure that the terminal building can adapt to future and unforeseen changes in technology and passenger behaviors.

i. Traditional Counters

Step 1: Calculate the approximate number of desks using the following equations:

$$CD_V = (PHP * PK * (1 - P_j - P_f) * CR * PT_V / 60) / (30 + MQT_V)$$

$$CD_J = (PHP * PK * P_j * CR * PT_J / 60) / (30 + MQT_J)$$

¹⁰⁸ ICAO Doc 9184-AN/902, Airport Planning Manual Second Edition, Part 1, Section 9.4.10, 1987

¹⁰⁹ IATA ADRM 10th Edition, Section 3.4.11.6, 2017

¹¹⁰ Refer to 109

$$CD_f = (PHP * PK * P_f * CR * PT_f / 60) / (30 + MQT_f)$$

The peak 30-minute factor is usually derived from the design day flight schedules (DDFS).

$CD_{(Y/J/f)}$	=	Approximate Number of Check-in Desks for Economy/Business/First Class Passengers
PHP	=	Originating Peak Hour Passengers
PK	=	Peak 30-minute Factor (in % of PHP)
Cf	=	Correction Factor for Demand Variability (see reference table)
$P_{(J/f)}$	=	Proportion of Business/First Class Passengers (in % of PHP)
CR	=	Ratio of Passengers Using Traditional Check-in Facilities
$PT_{(Y/J/f)}$	=	Process Time per Passenger at Check-in Desks for Economy/Business/First Class Passengers (in seconds)
$MQT_{(Y/J/f)}$	=	Maximum Queuing Time for Economy/Business/First Class Passengers (in minutes)
A	=	Area Required for the Check-in Desks Facility
CD	=	Total Number of Check-in Desks
CDd	=	Depth of the Check-in Process Area (in feet), including a courtesy distance between desks and queue. Refer to Figure 47, Figure 48, and Figure 49 for PA minimum standards.
CDw	=	Width of One Check-in Desk (in feet). Obtained from typical dimensions
QMAX	=	Maximum Number of Passengers Waiting in Queue at Check-in Desks
SP	=	Space per Person (in sq ft)
W	=	Corridor Width (in feet)*

* The corridor width will vary with the importance of passenger flows. Port Authority minimum standard width is 20 feet for all circulation corridors.

Table 7: Traditional counter calculation inputs¹¹¹

The maximum waiting times (MQT) summarized in the table below are to be used for the calculation of required traditional check-in counters.

Port Authority Criteria	
WAITING TIME STANDARDS FOR PROCESSING FACILITIES Not To Exceed (Minutes)	
Standard Counters	
Economy Class (MQT_y)	10 min
Premium Counters	
Business Class (MQT_j)	3 min
First Class (MQT_f)	3 min

Table 8: PA Maximum waiting times for traditional counters calculation

¹¹¹ IATA ADRM 10th Edition

These maximum waiting times should be used to determine the number of required processors (traditional counters) but not for the calculation of space requirements, including sizing of queue areas. The Port Authority requires that queue area be designed to accommodate a 30-minute queue time (see Step 3).

Step 2: Adjust requirements to account for variability in passenger arrival distribution within the peak period and in processing time using the following equation:

$$CD = CD_V * Cf + CD_I * Cf + CDf * Cf$$

Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)	
For MQT	CF
3, and less	1.22
4	1.22
5	1.15
10	1.06
15	1.01
20	1.00
25	1.00
30	1.00

Table 9: Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)¹¹²

The smaller the MQT, the greater the variability in demand over the 30-minute period analysis. The correction factor (CF) will apply to each desk type.

Step 3: Calculate the maximum number of passengers in the queue using the following equation:

Step 3a. Calculate the number of economy OR business OR first class passengers in the queue by looking at the individual Peak 30-minute demand for that particular segment, as used in Step 1.

$$QMAX = 0.495 * \text{Peak 30-min (corresponding to a 30-minute MQT)}$$

All queue areas at traditional counters should 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. When designing a queue area at a processing facility, the planner should choose either a single or snake queue layout. The typical width of a queue should be between 4.6 and 5.2 feet.

Step 4: Calculate the area required for the passenger processing element of the departures hall using the following equation:

$$A = (CD * CDd * CDw) + QMAX * SP + (CD * CDw * W)$$

Remember that the passenger processing hall is composed of the process area (CD * CDd * CDw), plus the queuing area (QMAX * SP), plus a circulation area (CD * CDw * W).

¹¹² IATA ADRM 10th Edition

The minimum space per person standards (SP) presented in the table below should be used for the calculation of space requirements for traditional counters:

Port Authority Standard	
SPACE STANDARDS FOR QUEUE AREAS (sf/pax)* - MINIMUM	
Domestic Flights	16.1
International Flights	19.4

*Considering a queue width of 4.5 to 5.0 feet.¹¹³

Table 10: Space standards for queue areas

ii. Self-Service Kiosks

Step 1: Calculate the approximate number of self-service kiosks using the following equation:

$$SSi = (PHP * PK * SSR * PT / 60) / (30 + MQT)$$

SSi	=	Approximate Number of Self-Service Kiosks
PHP	=	Originating Peak Hour Passengers
Cf	=	Correction Factor for Demand Variability (see reference table)
PK	=	Peak 30-minute Factor (in % of PHP)
SSR	=	Ratio of Passengers Using Self-Service Kiosks
PT	=	Process Time per Passenger at Self-Service Kiosk (in seconds)
MQT	=	Maximum Queuing Time (in minutes)
A	=	Area Required for the Self-Service Kiosks
SS	=	Total Number of Self-Service Kiosks
SSa	=	Area Occupied by a Single Self-Service Kiosk. (obtained from typical dimensions)
AA	=	Adjustment Area for a Single Self-Service Kiosk (to account for additional area needed for layout-obtained from typical dimensions)
QMAX	=	Maximum Number of Passengers Waiting in Queue
SP	=	Space per Person (in sq ft)
CAF	=	Circulation Area Factor (in %)

Table 11: Self-service kiosks calculation inputs¹¹⁴

The maximum waiting times (MQT) summarized in the table below are to be used for the calculation of required traditional check-in counters.

¹¹³ IATA ADRM 10th Edition

¹¹⁴ IATA ADRM 10th Edition

Some kiosks do not provide capability to check bags or print bag tags. They are usually clearly labeled “Check-in Only, No Checked Bags” or similar. They may be able to print boarding passes only.

Port Authority Standard	
WAITING TIME STANDARDS FOR PROCESSING FACILITIES Not To Exceed (Minutes)	
Check-in Only	
Economy Class	1 min
First / Business Class	1 min
Check-in, Baggage Check, Weighing, and Tag	
Economy Class	2 min
First / Business Class	2 min

Table 12: PA Maximum waiting times for self-service kiosks calculation

These maximum waiting times should be used to determine the number of required processors (traditional counters) but not for the calculation of space requirements, including sizing of queue areas. The Port Authority requires that queue area be designed to accommodate a 10-minute queue time (see Step 3).

Step 2: Adjust requirements to account for variability in passenger arrival distribution within the peak period and in processing time using the following equation:

$$SS = SS_i * C_f$$

Where:

Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)	
For MQT	CF
3, and less	1.22
4	1.22
5	1.15
10	1.06
15	1.01
20	1.00
25	1.00
30	1.00

Table 13: Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)¹¹⁵

The smaller the MQT, the greater the variability in demand over the 30-minute period analysis.

Step 3: Calculate the maximum number of passengers in queue using the following equation:

$$Q_{MAX} = 0.289 * \text{Peak 30-min (corresponding to a 10-minute MQT)}$$

Step 4: Calculate the area required for the self-service process using the following equation:

$$A = [(SS * SS_a * AA) + (Q_{MAX} * SP)] * (1 + CAF)$$

¹¹⁵ IATA ADRM 10th Edition

The minimum space per person standards (SP) presented in the table below should be used for the calculation of space requirements for self-service counters:

Port Authority Standard	
SPACE STANDARDS FOR QUEUE AREAS (sf/pax)* - MINIMUM	
Domestic Flights	16.1
International Flights	19.4

*Considering a queue width of 4.5 to 5.0 feet.¹¹⁶

Table 14: Space standards for queue areas

It must be noted that the adjustment factor applies only to the equipment (kiosk) footprint. Since the equipment is relatively small, it cannot be aligned like traditional desks. Space is needed around it to allow passengers to make their transaction in a comfortable way. The adjustment factor (AA) depends on the layout and configuration of the kiosks.

The circulation area factor (CAF) is introduced to provide additional space for circulating through and around this processing area.

iii. Baggage Drop Induction Points

Step 1: Calculate the approximate number of baggage drop positions using the following equations:

$$BD_v = (PHP * PK * (1 - P_j - P_f) * (1 - CR) * PT_v / 60) / (30 + MQT_v)$$

$$BD_j = (PHP * PK * P_j * (1 - CR) * PT_j / 60) / (30 + MQT_j)$$

$$BD_f = (PHP * PK * P_f * (1 - CR) * PT_f / 60) / (30 + MQT_f)$$

¹¹⁶ IATA ADRM 10th Edition

BD _(Y/J/f)	=	Approximate Number of Baggage Drop Positions for Economy/Business/First Class Passengers
PHP	=	Originating Peak Hour Passengers
Cf	=	Correction Factor for Demand Variability (see reference table)
PK	=	Peak 30-minute Factor (in % of PHP)
P _(J/f)	=	Proportion of Business/First Class Passengers (in % of PHP)
CR	=	Ratio of Passengers Using Traditional Check-in Facilities
PT _(Y/J/f)	=	Process Time per Passenger at Baggage Drop for Economy/Business/First Class (in seconds)
MQT _(Y/J/f)	=	Maximum Queuing Time for Economy/Business/First Class Passengers (in minutes)
A	=	Area Required for the Baggage Drop Facility
BD	=	Total Number of Baggage Drop Positions
BDd	=	Depth of the Baggage Drop Process Area (in feet), including a courtesy distance between desks and queue. Obtained from typical dimensions.
BDw	=	Width of One Baggage Drop Position (in feet). Obtained from typical dimensions
QMAX	=	Maximum Number of Passengers Waiting in Queue at Baggage Drop
SP	=	Space per Person (in sq ft)
W	=	Corridor Width (in feet).*

* The corridor width will vary with the importance of passenger flows. Port Authority minimum standard width is 20 feet for all circulation corridors.

Table 15: Baggage drop calculation inputs¹¹⁷

The maximum waiting times (MQT) summarized in the following table are to be used for the calculation of required baggage drops.

Port Authority Standard	
WAITING TIME STANDARDS FOR PROCESSING FACILITIES	
Not to Exceed (Minutes)	
Standard Counters	
Economy Class (MQT _y)	3 min
Premium Counters	
Business Class (MQT _b)	2 min
First Class (MQT _f)	2 min

Table 16: PA Maximum waiting times for baggage drop inductions points calculation

These maximum waiting times should be used to determine the number of required processors (traditional counters) but not for the calculation of space requirements, including sizing of queue areas. The Port Authority requires that queue area be designed to accommodate a 10-minute queue time (see Step 3).

¹¹⁷ IATA ADRM 10th Edition

Step 2: Adjust requirements to account for variability in passenger arrival distribution within the peak period and in processing time using the following equation:

$$BD = BD_v * Cf + BD_j * Cf + BD_r * Cf$$

Where:

Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)	
For MQT	CF
3, and less	1.22
4	1.22
5	1.15
10	1.06
15	1.01
20	1.00
25	1.00
30	1.00

Table 17: Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)¹¹⁸

The smaller the MQT, the greater the variability in demand over the 30-minute period analysis. The correction factor will apply to each desk type.

Step 3: Calculate the maximum number of passengers in queue using the following equation:

$$QMAX = 0.289 * \text{Peak 30-min (corresponding to a 10-minute MQT)}$$

Step 3a, b or c: Calculate the number of economy OR business OR first-class passengers in the queue by looking at the individual Peak 30-minute Factor for that particular segment, as used in Step 1.

Note: Calculate the number of economy, business and first class passengers in the queue by looking at the individual Peak 30-Minute Factor for that segment and then add the segments together to calculate the total.

Step 4: Calculate the area required for the baggage drop facility using the following equation:

$$A = (BD * BDd * BDw) + QMAX * SP + (BD * BDw * W)$$

The corridor width will vary with the importance of passenger flows. Port Authority minimum standard width is 20 feet for all circulation corridors.

The minimum space per person standards (SP) presented in the table below should be used for the calculation of space requirements for baggage-drop counters:

¹¹⁸ IATA ADRM 10th Edition

Port Authority Standard	
SPACE STANDARDS FOR QUEUE AREAS (sf/pax)* - MINIMUM	
Domestic Flights	16.1
International Flights	19.4

*Considering a queue width of 4.5 to 5.0 feet.

Table 18: Space standards for queue areas¹¹⁹

e. Dimensional Criteria

1. Traditional Counters

The dimensional guidelines for the most common airline agent check-in position modules are approximately 380 square feet for domestic counter positions, 420 square feet for international counter positions, and 460 square feet for international counters with automated take-away conveyors. 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

¹¹⁹ IATA ADRM 10th Edition

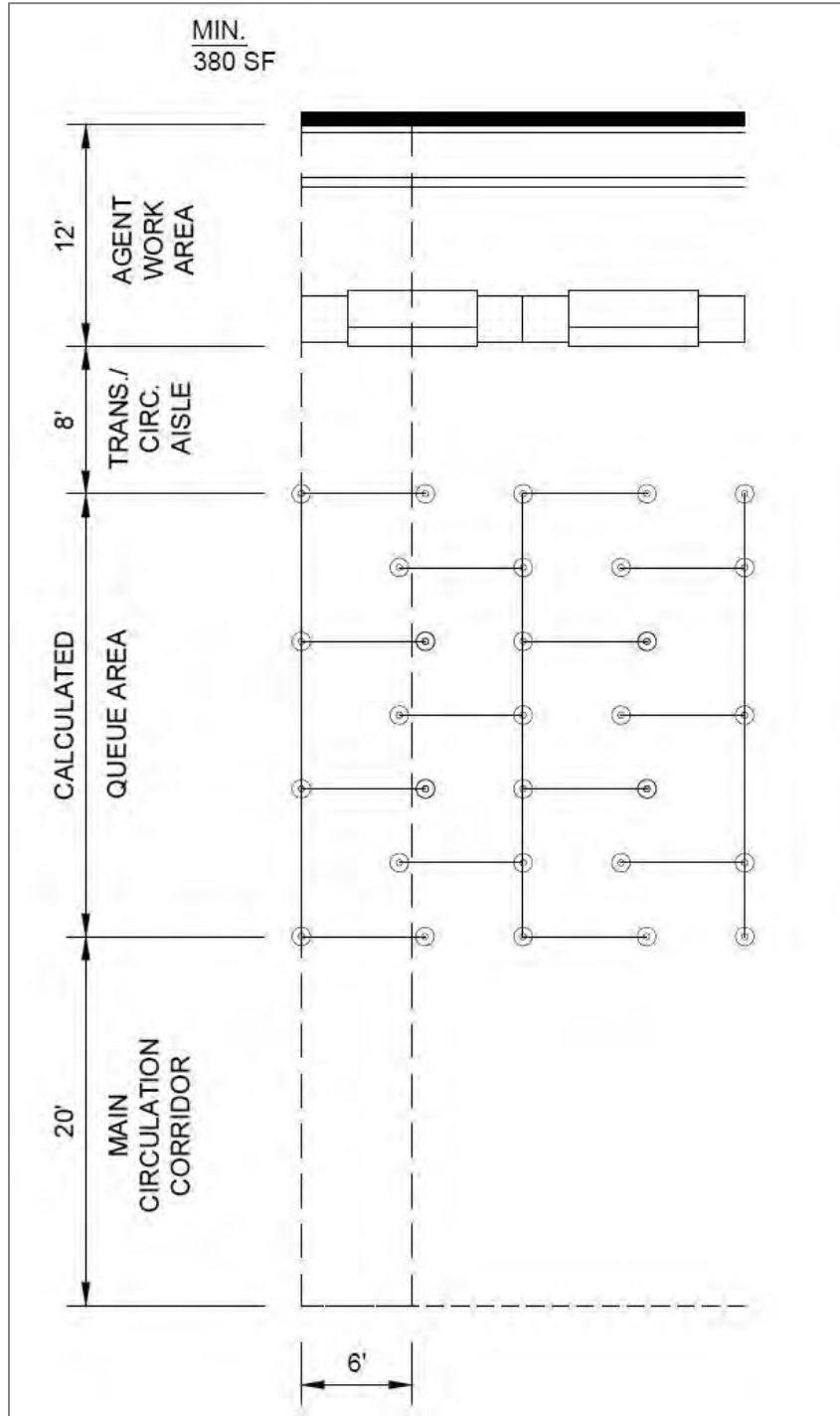


Figure 47: Typical Layout for Standard Domestic Check-in Counters

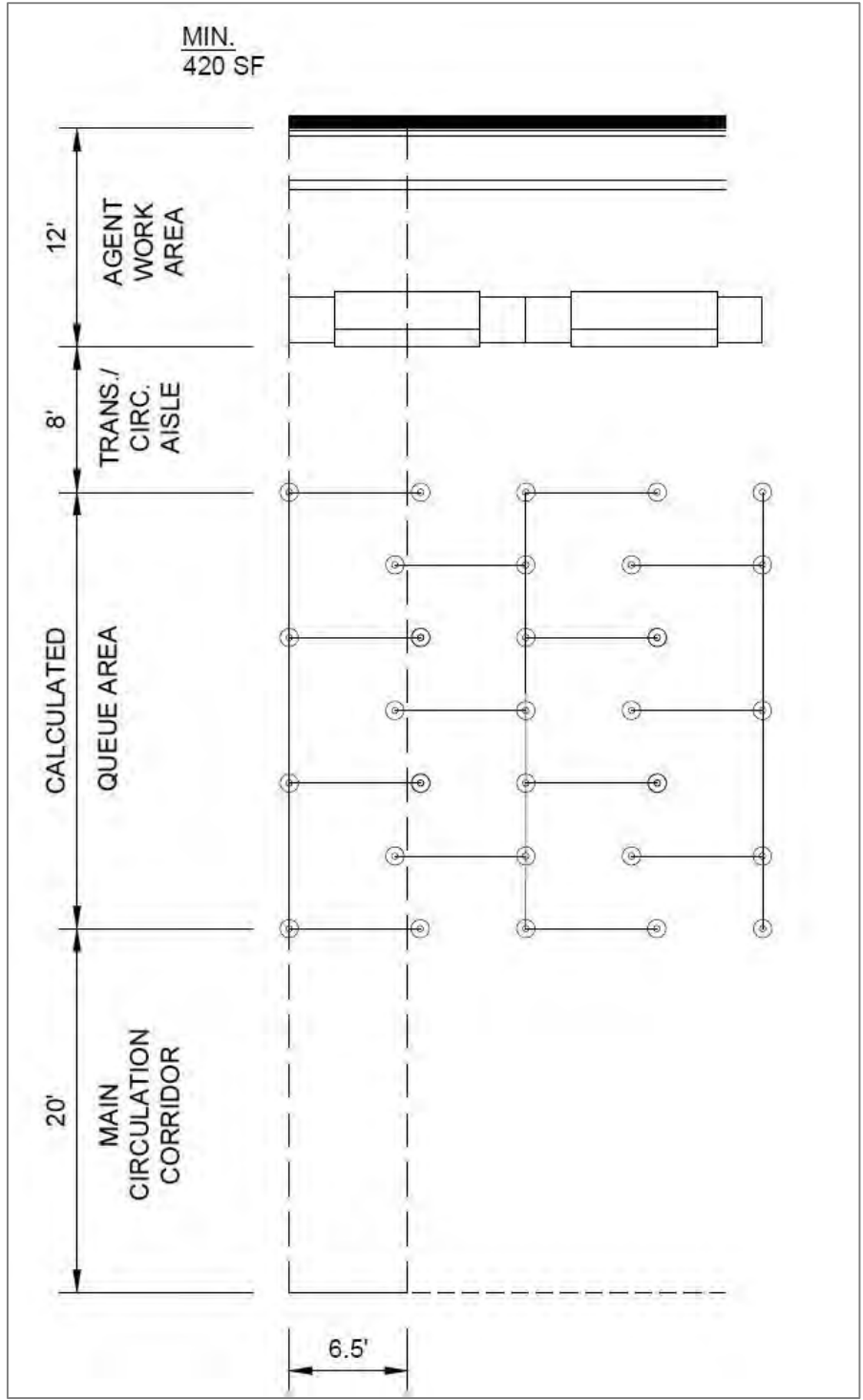


Figure 48: Typical Layout for Standard International Check-in Counters

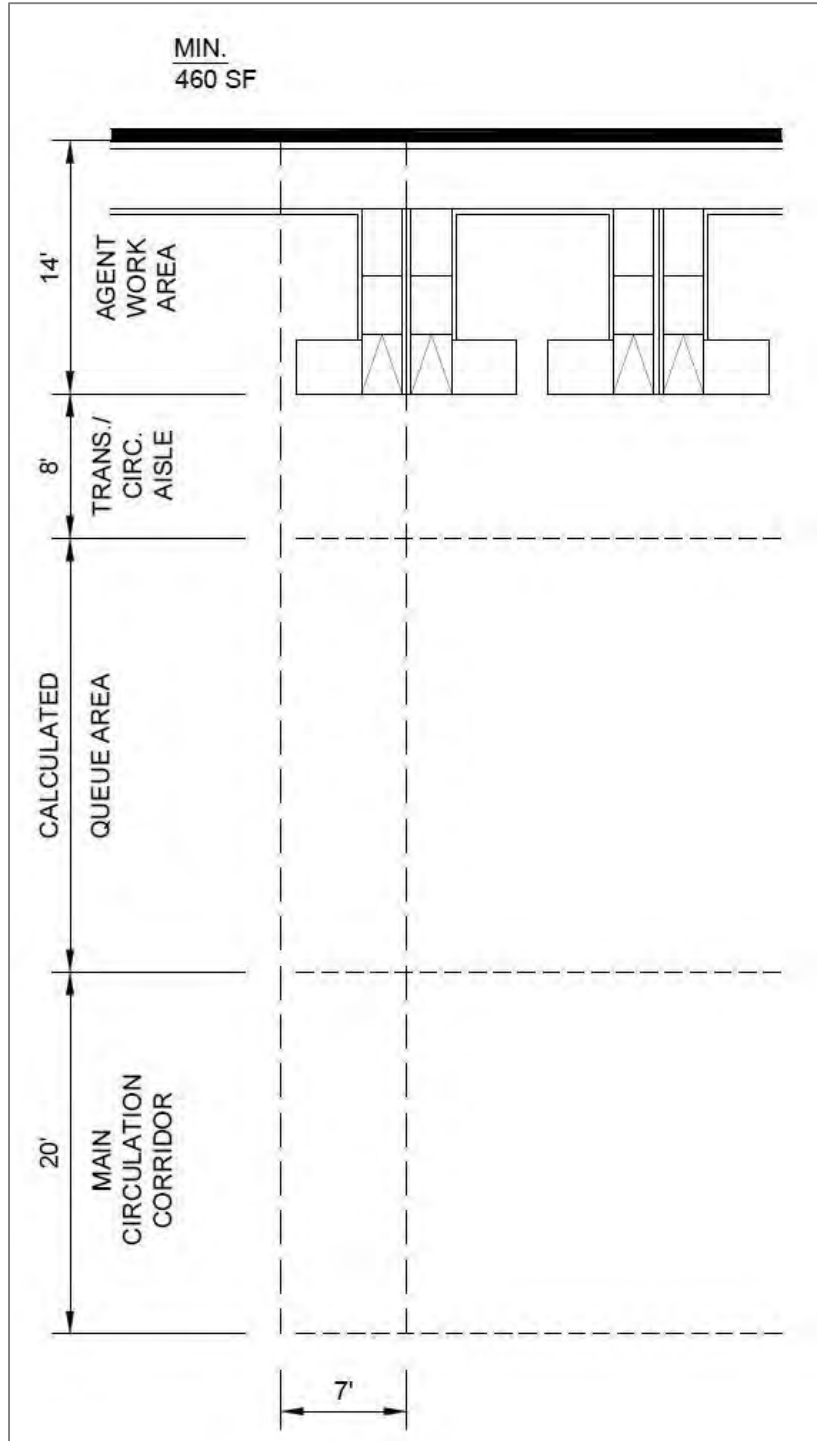


Figure 49: Typical Layout for International Check-in Counters with Automated Take-Away belt

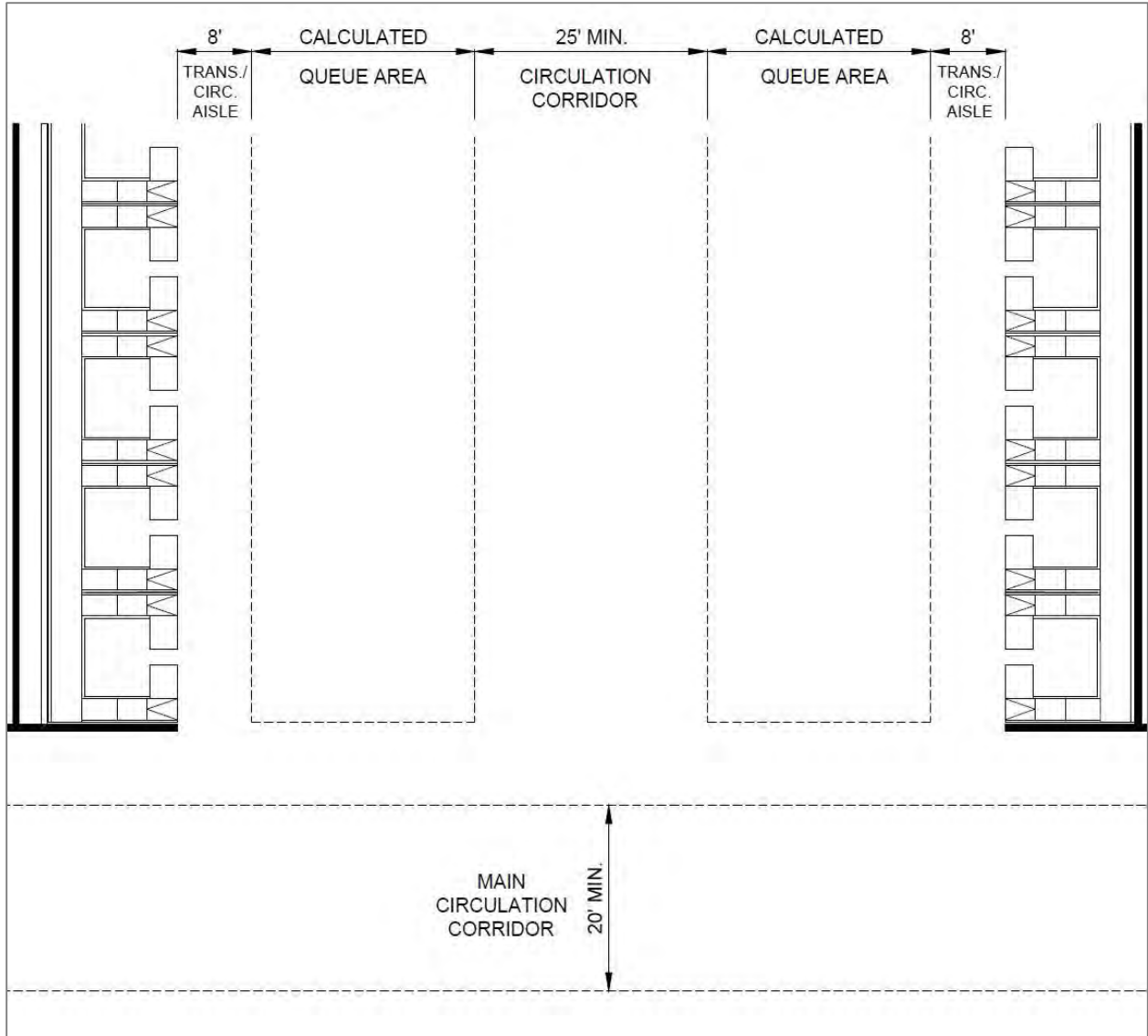


Figure 50: Typical Layout for Standard International Check-in Counters (configured in parallel islands)

2. Self-Service Kiosks

[Section under development]

3. Oversize baggage

Facilities should also be provided for odd-sized or oversized baggage, such as golf clubs, skis, and packages that are too large to fit on the baggage claim units or may cause jams on feed conveyors.

f. Outbound Baggage Handling System (BHS)

1. Processing Elements Calculation - Methodology

i. Baggage screening demand

The methodology in determining baggage screening demand shall use the latest version of the TSA's Planning Guidelines and Design Standards for Checked Baggage Inspection Systems (PGDS) Chapter 5 for guidance. The document captures TSA's requirements for a CBIS project from the beginning stages of design through commissioning of the system. The scope of the design is to be discussed on a case-by-case basis between the project sponsor and TSA. All other design standards in conjunction with TSA's PGDS will follow the industry's best practice.

The estimation of oversized baggage demand as a percentage of overall baggage should be checked against historical data of each terminal. Provide a means of conveying oversized baggage from the departures hall to the CBIS. This could be via special oversize belts, or manual conveyance, depending on demand levels and building configuration.

ii. Take-Away & Collector Belts

Main lines taking bags away from the EDS machine shall be capable of transporting bags equal to or greater than the capacity of the non-redundant EDS machines¹²⁰.

2. EDS Equipment Requirements¹²¹

The following key steps must be completed to determine EDS equipment requirements:

- Group airlines into screening zones or a common screening area
- Project design year baggage demand for each screening zone
- Surge design year baggage demand for each screening zone
- Select CBIS type and EDS equipment type (a list of system types, including EDS equipment types and their throughputs)

EDS equipment requirements shall be based on surged flows obtained by multiplying the design year design day checked baggage flow by a zone-specific surge factor* for each 10-minute bin. The use of a surge factor is recommended to capture the intrinsic variance of baggage demand and to ensure that equipment requirements are not undersized. For mini in-line systems the application of a surge factor may not be required. This will be at TSA's discretion. The following formula shall be used to calculate the surge factor:

$$SF = \frac{x + 2 \sqrt{x}}{x}$$

Where:

SF = Surge Factor

x = 10-minute baggage flow

¹²⁰ TSA PGDS Version 5, Section 7.2.1.1, 2015

¹²¹ TSA PGDS Version 5, Section 6.1.1, 2015

To calculate EDS equipment requirements, the surged peak 10-minute design year baggage flow is first converted to surged peak-hour design year baggage flow and then divided by the EDS machine throughput (95% throughput)

$$N_{EDS} = \frac{\text{SurgedPeak10Minute Flow} \times 6}{\text{Throughput}_{EDS}}$$

N_{EDS} = Number of EDS machines

Throughput_{EDS} = Number of EDS screened bags per hour

i. On Screen Resolution (OSR) Station Requirements¹²²

For certain system types, OSR can be centralized and remotely located.

The degree of centralization can also vary from totally centralized OSR systems that serve the entire airport to OSR systems dedicated to each CBIS. If the system type supports a remotely located OSR system, several considerations should guide the selection of the appropriate degree of system centralization, including TSA staffing, space requirements, and information technology (IT) infrastructure requirements.

Thus, to select the best OSR system type and location, it is recommended that OSR options be evaluated by assessing OSR staffing needs, capital costs of IT infrastructure and building modifications, and O&M costs associated with each option.

The number of OSR stations to be installed shall be derived based on the total non-redundant EDS capacity. The size of the OSR Room in terms of space allocation shall be based on the number of OSR stations derived based on the total EDS capacity including redundant units.

The number of OSR stations (N_{OSR}) required shall be calculated as follows:

$$N_{OSR} = \frac{N_{EDS} \times \text{Throughput}_{EDS} \times FA_{EDS}}{\text{Throughput}_{OSR}}$$

$N_{EDS} \times \text{Throughput}_{EDS}$ = Sum of total EDS capacity (throughput) for all EDS machines connected to the remote OSR system

FA_{EDS} = EDS false alarm rate for the EDS equipment selected

Throughput_{OSR} = 3600 / Screening Processing Time_{OSR}

Where:

Screening Processing Time_{OSR} = Average screening time that the OSR operator needs for each bag

ii. Baggage Inspection Table Requirements¹²³

BITs are accommodated in CBRAs. In general, an ETD machine is shared between two TSOs because the amount of time the ETD machine is used during the total screening process for a bag is relatively short. Thus, the ratio of BITs to ETD equipment is typically 2:1.

¹²² TSA PGDS Version 5, Section 6.1.3, 2015

¹²³ TSA PGDS Version 5, Section 6.1.4, 2015

The number of BIT stations to be installed shall be derived based on the total non-redundant EDS capacity. The size of the CBRA in terms of space allocation shall be based on the number of BIT stations derived based on the total EDS capacity.

$$N_{BIT} = N_{\text{Alarmed/OOG}} + N_{\text{ETD Protocol OS}}$$

$N_{\text{Alarmed/OOG}} = N_{\text{Alarmed/OOG Domestic}} + N_{\text{Alarmed/OOG International}}$ and round to the next whole integer value

$$N_{\text{Alarmed/OOG Domestic}} = \frac{N_{\text{EDS}} \times \text{Throughput}_{\text{EDS}} \times \% \text{ Domestic} \times [F_{\text{AEDS}} \times (1 - \text{CROSR}) + R_{\text{LIT}} + \text{EDS}_{\text{Error}}]}{\text{Throughput}_{\text{Directed Search Domestic Rate}}}$$

$$+$$

$$\frac{N_{\text{EDS}} \times \text{Throughput}_{\text{EDS}} \times \% \text{ Domestic OOG}}{\text{Throughput}_{\text{ETD Protocol Domestic OOG Rate}}}$$

$$N_{\text{Alarmed/OOG International}} = \frac{N_{\text{EDS}} \times \text{Throughput}_{\text{EDS}} \times \% \text{ International} \times [F_{\text{AEDS}} \times (1 - \text{CROSR}) + R_{\text{LIT}} + \text{EDS}_{\text{Error}}]}{\text{Throughput}_{\text{Directed Search International Rate}}}$$

$$+$$

$$\frac{N_{\text{EDS}} \times \text{Throughput}_{\text{EDS}} \times \% \text{ International OOG}}{\text{Throughput}_{\text{ETD Protocol International OOG Rate}}}$$

$N_{\text{ETD Protocol OS}} = N_{\text{ETD Protocol Domestic}} + N_{\text{ETD Protocol International}}$ and round to the next whole integer value

$$N_{\text{ETD Protocol Domestic}} = \frac{N_{\text{EDS}} \times \text{Throughput}_{\text{EDS}} \times \% \text{ Domestic OS}}{\text{Throughput}_{\text{ETD Protocol Domestic OS Rate}}}$$

$$N_{\text{ETD Protocol International}} = \frac{N_{\text{EDS}} \times \text{Throughput}_{\text{EDS}} \times \% \text{ International OS}}{\text{Throughput}_{\text{ETD Protocol International OS Rate}}}$$

Where:

N_{EDS} = the total quantity of EDS machines (non-redundant for determining equipment to be actually installed; including redundant for determining space allocation)

Throughput_{EDS} = the rate of the EDS equipment selected

% Domestic OOG = the expected percentage of Domestic Out of Gauge baggage

% International OOG = the expected percentage of International Out of Gauge baggage

% Domestic OS = the expected percentage of Domestic Oversize baggage

% International OS = the expected percentage of International Oversize baggage

EDS_{Error} = the expected EDS error rate percentage (typically 1%)

N_{BIT} = the minimum quantity of baggage inspection tables that are required in the CBRA

$N_{\text{Directed Search}}$ = quantity of baggage inspection tables that are allotted for the directed search of Domestic and International baggage

$N_{\text{Directed Search Domestic}}$ = quantity of baggage inspection tables that are allotted for the directed search of Domestic baggage

$N_{\text{Directed Search International}}$ = quantity of baggage inspection tables that are allotted for the directed search of International baggage

CROSR = OSR clear rate

R_{LIT} = the percentage of the bags sent through the EDS machines that are anticipated to be “Lost in Tracking” (i.e., to become “Unknowns”; typically, 2%)

Throughput Directed Search Domestic Rate = the capability of the TSO to process Domestic baggage expressed as a bags per hour rate per TSO

Throughput Directed Search International Rate = the capability of the TSO to process International baggage expressed as a bags per hour rate per TSO

N ETD Protocol OS/OOG = the quantity of baggage inspection tables that are allotted for the ETD protocol search of Out of Gauge and Oversize baggage for both Domestic and International passengers

N ETD Protocol Domestic = the quantity of baggage inspection tables that are allotted for the ETD protocol search of Out of Gauge and Oversize baggage for Domestic passengers

N ETD Protocol International = the quantity of baggage inspection table that are allotted for the ETD protocol search of Out of Gauge and Oversize baggage for International passengers

Throughput ETD Protocol Domestic OS/OOG Rate = the capability of the TSO to process Domestic Oversize and Out of Gauge baggage expressed as a bags per hour rate per TSO

Throughput ETD Protocol International OS/OOG Rate = the capability of the TSO to process International Oversize and Out of Gauge baggage expressed as a bags per hour rate per TSO

FA_{EDS}= EDS false alarm rate for the EDS equipment selected

iii. ETD Machine Requirements¹²⁴

The ratio of BITs to ETD equipment is typically 2 to 1.

$$N_{\text{ETDMachines}} = N_{\text{BIT}} / 2 \text{ (Round up to the next ETD)}$$

3. Checked Baggage Resolution Area (CBRA)

i. CBRA Layout and Equipment¹²⁵

The CBRA layout shall be designed to optimize TSO utilization, minimize bag lifting, and reduce equipment costs. A centralized CBRA can optimize TSO utilization and equipment cost reduction.

- Incorporate a Re-Insert Line (RL) connected to the end of the Alarm Line (AL) and omit the RL queue side guard to ease bag placement during manual reinsertion
- Enable transport of OOG bags via the AL and leave via the Clear Line (CL)
- Enable transport of oversized bags via a dedicated conveyor line
- Ensure that bags arriving on the AL are centered or closer to the Baggage Inspection Table (BIT) side (not to the conveyor side guard)
- Define Transportation Security Officer (TSO) access path to the oversized bag area

ii. CBRA Physical Requirements

The quantitative sizing of the room should be based on the number of queues and workstations required to adequately meet the screening demands of the CRBA.

iii. Make-up

Baggage make-up includes manual or automated make-up units, the cart/container staging areas, and baggage tug/cart (baggage train) maneuvering lanes. The type of system selected for a terminal depends

¹²⁴ TSA PGDS Version 5, Section 6.1.5, 2015

¹²⁵ TSA PGDS Version 5, Section 9.2.1, 2015

on several factors including the number of airlines, the terminal configuration, operating policies (common use, exclusive use), and size of the terminal complex¹²⁶.

The Baggage Make-Up model estimates the make-up requirement based on the total Equivalent Aircraft (EQA) [1 EQA = 145 seats] of gates in use, the average number of departures per nominal gate (not normalized to EQA) in the make-up period, and the likely number of staged carts/containers required per EQA. The EQA value can be linked to the Gate Demand model, but can also be entered manually¹²⁷.

Although checked baggage ratios are a consideration, especially when designing more complicated automated sortation systems, these ratios generally affect the total number of baggage carts in use rather than the size of the make-up area. The number of carts/containers per flight staged at any one time, however, is generally based on the size of the aircraft. For most terminals, one cart or container is typically staged for each 50 to 75 seats of aircraft capacity; this would be equivalent to approximately two to three carts/containers per EQA. A cart is usually assumed to have the capacity for 40 to 50 bags. The number of staged carts/containers can also vary based on individual airline policies for pre-sorting baggage at the spoke airport for more efficient transfer at the hub.

iv. Make-Up Devices

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.

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)

The total number of make-up positions (MUPs) is dependent number of flights in build at any one time and allocations per flight type (ADG-III - 3 to 4; ADG-V - 5 to 6). The assumption used for MUP allocations assumption needs to be defined on airport by airport basis. An EBS can also reduce MUP demand by reducing make-up opening time but must be sized accordingly.

¹²⁶ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.12.1, 2010

¹²⁷ ACRP Report 25, Vol 2, Airport Passenger Terminal Planning and Design, Baggage Make-up Model, 2010

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

ACRP 25, Volume 2 provides the methodology followed to determine the make-up area required.

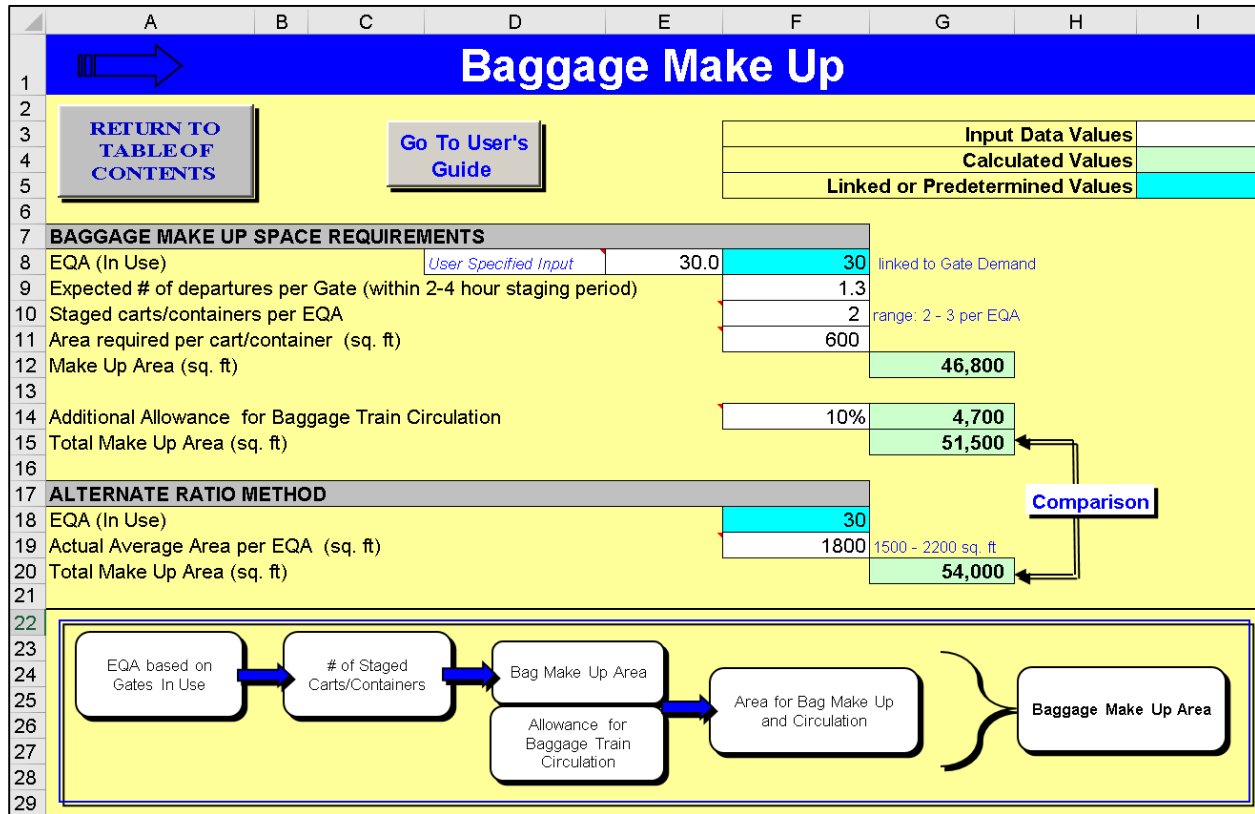


Figure 51: Sample calculation screen

g. Oversized Baggage

The estimation of oversized baggage demand as a percentage of overall baggage should be checked against historical data of each terminal. Provide a means of conveying oversized baggage from the departures hall to the CBIS. This could be via special oversize belts, or manual conveyance, depending on demand levels and building configuration.

1. Dimensional Criteria

i. Take-Away & Collector Belts:

The following passage, from TSA PGDS, discusses design considerations for conveyor belt speeds and slopes.

ii. Tail-to-Head Bag Spacing Requirement¹²⁸

The space between bags as measured from the trailing edge of leading bag to the leading edge of the trailing bag, or “tail-to-head spacing” shall be no less than 12 inches as bags enter the EDS machine. The speed of the queue belt immediately before and after the EDS machine shall match the speed of the internal belt of the EDS.

iii. Gradual Conveyor Speed Transitions¹²⁹

The transitions in conveyor belt speeds between any two consecutive conveyor belts should not exceed 30 feet per minute or a 50% difference of belt speeds, whichever is less, so as not to affect the stability, orientation, or spacing of bags while still maintaining accurate bag tracking.

CBIS designers must match adjacent conveyor speeds at the juncture between BHS and EDS conveyors at both the entrance and exit of the EDS.

iv. Avoidance of Steep Conveyor Slopes¹³⁰

The CBIS should be designed with incline and decline angles no greater than 18 degrees in non-tracking zones (i.e., zones where bags are not positively tracked) and no greater than 12 degrees in tracking zones (i.e., zones where bags are positively tracked).

2. Checked Baggage Resolution Area (CBRA)

i. CBRA Layout and Equipment¹³¹

The CBRA layout shall be designed to optimize TSO utilization, minimize bag lifting, and reduce equipment costs. A centralized CBRA can optimize TSO utilization and equipment cost reduction.

- Incorporate a Re-Insert Line (RL) connected to the end of the Alarm Line (AL) and omit the RL queue side guard to ease bag placement during manual reinsertion
- Enable transport of OOG bags via the AL and leave via the Clear Line (CL)
- Enable transport of oversized bags via a dedicated conveyor line
- Ensure that bags arriving on the AL are centered or closer to the Baggage Inspection Table (BIT) side (not to the conveyor side guard)
- Define Transportation Security Officer (TSO) access path to the oversized bag area

ii. CBRA Physical Requirements

The quantitative sizing of the room should be based on the number of queues and workstations required to adequately meet the screening demands of the CBRA.

¹²⁸ TSA PGDS Version 5, Section 7.2.1.2, 2015

¹²⁹ TSA PGDS Version 5, Section 7.2.6.2.1, 2015

¹³⁰ TSA PGDS Version 5, Section 7.2.6.2.2, 2015

¹³¹ TSA PGDS Version 5, Section 9.2.1, 2015

iii. CBRA Layout and Equipment ¹³²

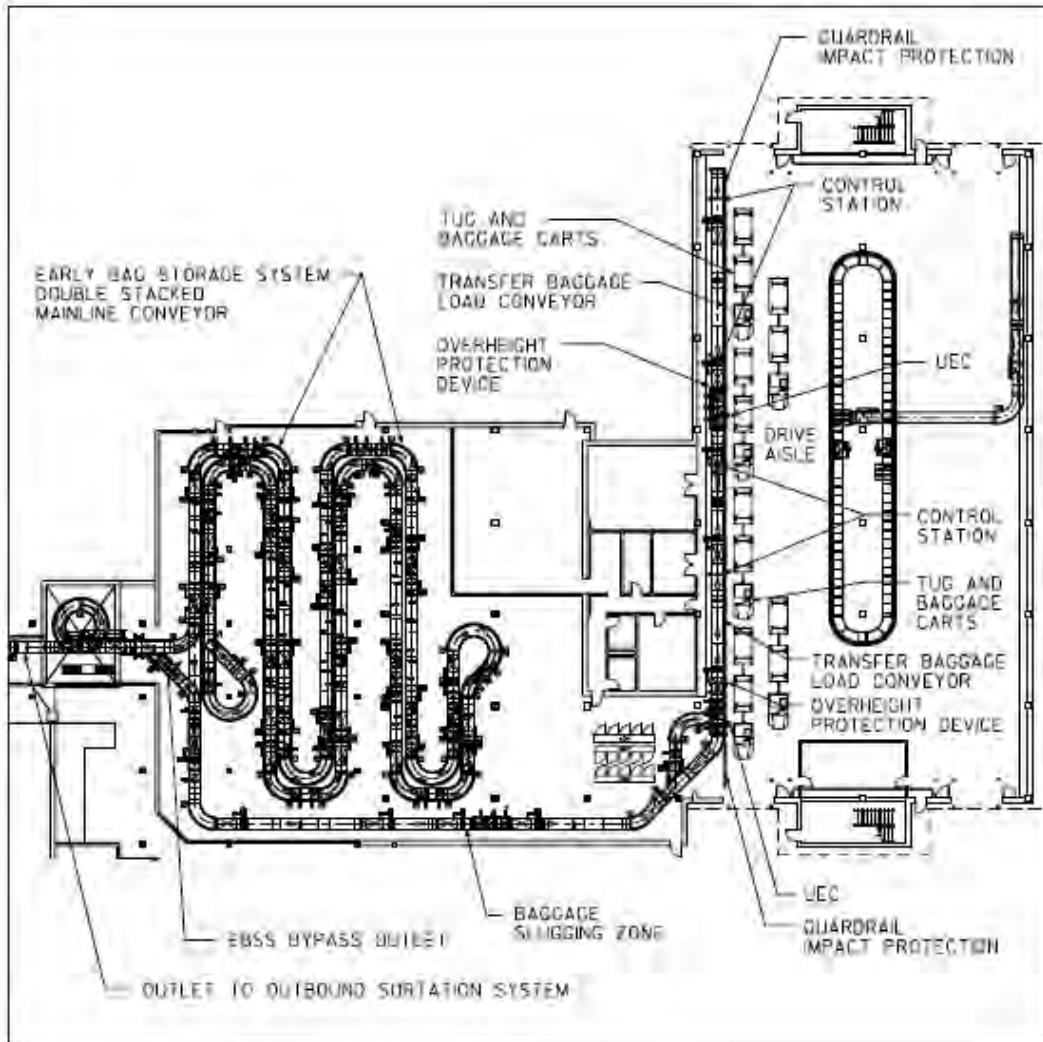
The following passage from TSA PGDS, discusses design considerations for TSA equipment sizing when designing the layout of CBRA.

The Baggage Inspection Table (BIT) is where TSOs perform baggage security screening protocols. The BITs shall be aligned with the AL and designed to provide a 30-inch by 60-inch minimum work surface with 30-inches of height.

The Baggage Removal Point (BRP) is the queue conveyor adjacent to the BIT from which bags are removed and transferred to the BIT. The BRP shall be 48 inches long and designed to a 32-inch height.

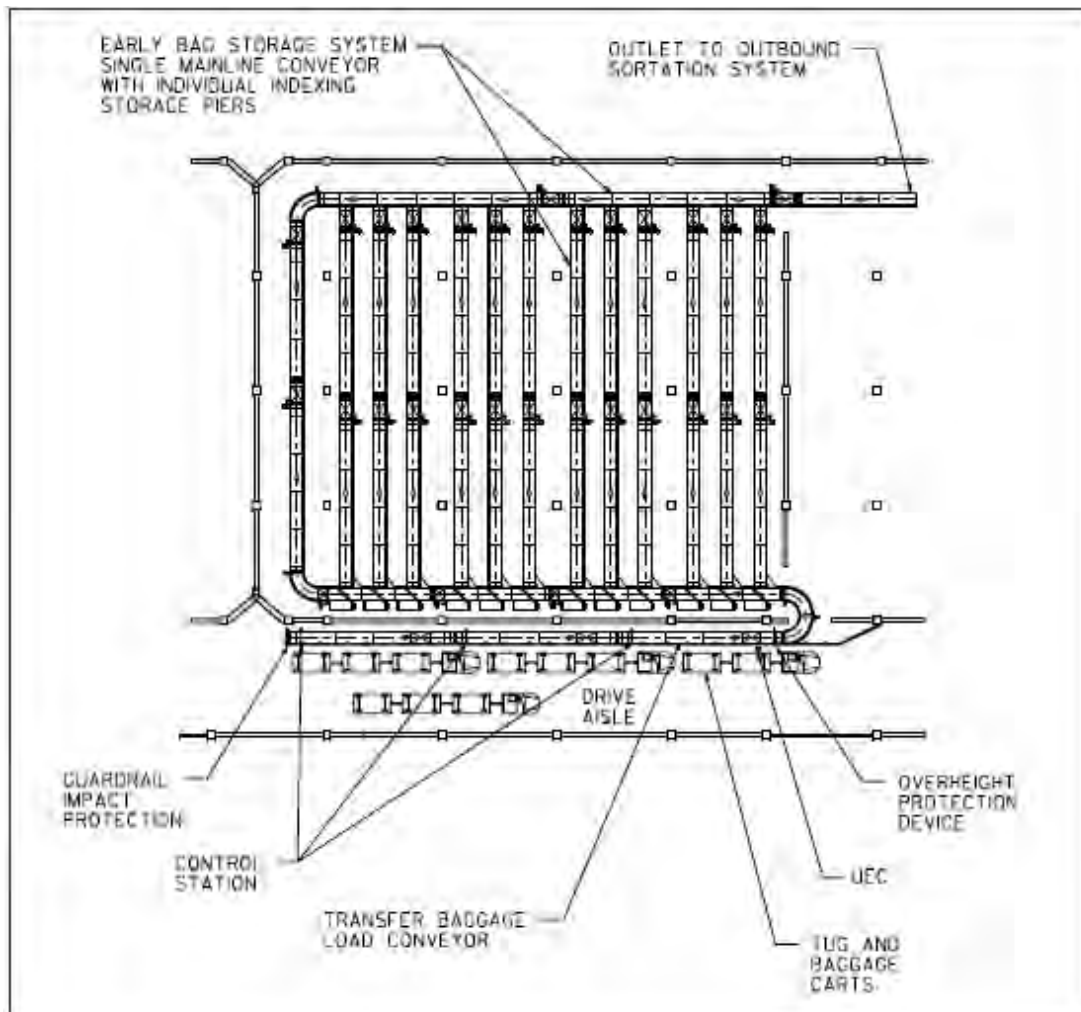
¹³² TSA PGDS Version 5, Section 9.2.1, 2015

3. Early Baggage Storage (EBS)



Source: Star Systems, LLC—A subsidiary of The Star Airport Alliance

Figure 52: Typical EBSS with double-stacked mainline conveyor and two load points



Source: Star Systems, LLC—A subsidiary of Pavo Star Airport

Figure 53: Typical EBSS with single mainline conveyor and one load point

4. Make-Up Room

The size of the baggage make-up area will vary depending on the type of make-up units (index belts, recirculating make-up units, sort piers, etc.) and whether the systems are exclusive or common use for typical configurations and dimensions. For preliminary planning purposes, the area per staged cart/container typically varies from 600 square feet/cart for individual airline make-up areas with recirculating make-up units to 300 square feet/cart for larger pier make-up areas. In addition to the area for baggage make-up and bag claim off-loading, most terminals need additional lanes and other common-use maneuvering areas that link the inbound and outbound baggage handling areas to the apron. For programming, a 10% to 15% allowance of all baggage handling areas will generally be sufficient for tug circulation in a two-level terminal, provided the terminal configuration is reasonably efficient¹³³.

¹³³ ACRP Report 25, Vol 2, Airport Passenger Terminal Planning and Design, Baggage Make-up Model, 2010

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, 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
- GSE requirements (e.g., tug charging, ULD storage, cart parking)
- Roadway design (e.g., number of lanes, lane width, turning radius)

The alternative ratio method uses a general rule-of-thumb approach based on the average makeup area in relation to total EQA. Generally, 1,500 to 2,200 square feet per EQA of overall make-up area is the range at airports that have been studied.

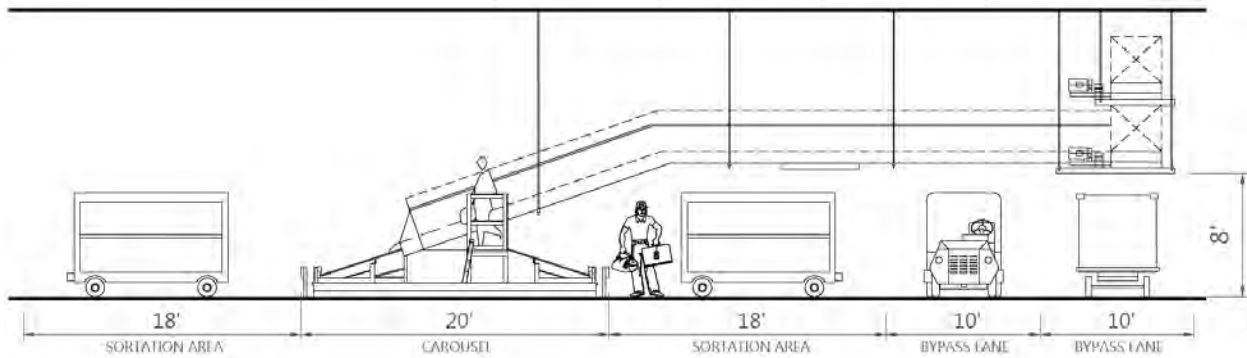


Figure 54: Schematic of baggage induction system ¹³⁴

¹³⁴ Source: ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, 2010

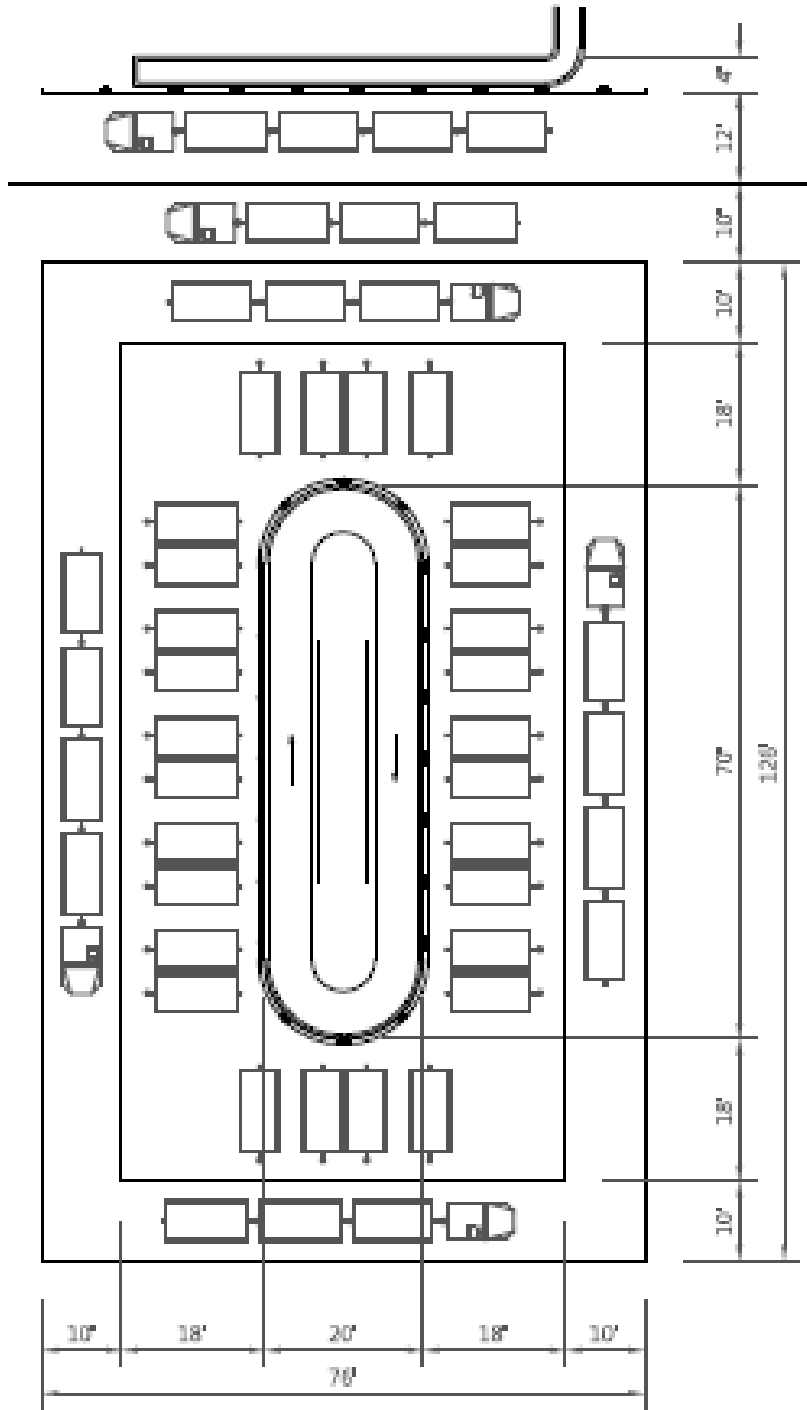


Figure 55: Outbound bag make-up benchmark with perpendicular staging ¹³⁵

¹³⁵ Source: ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, 2010

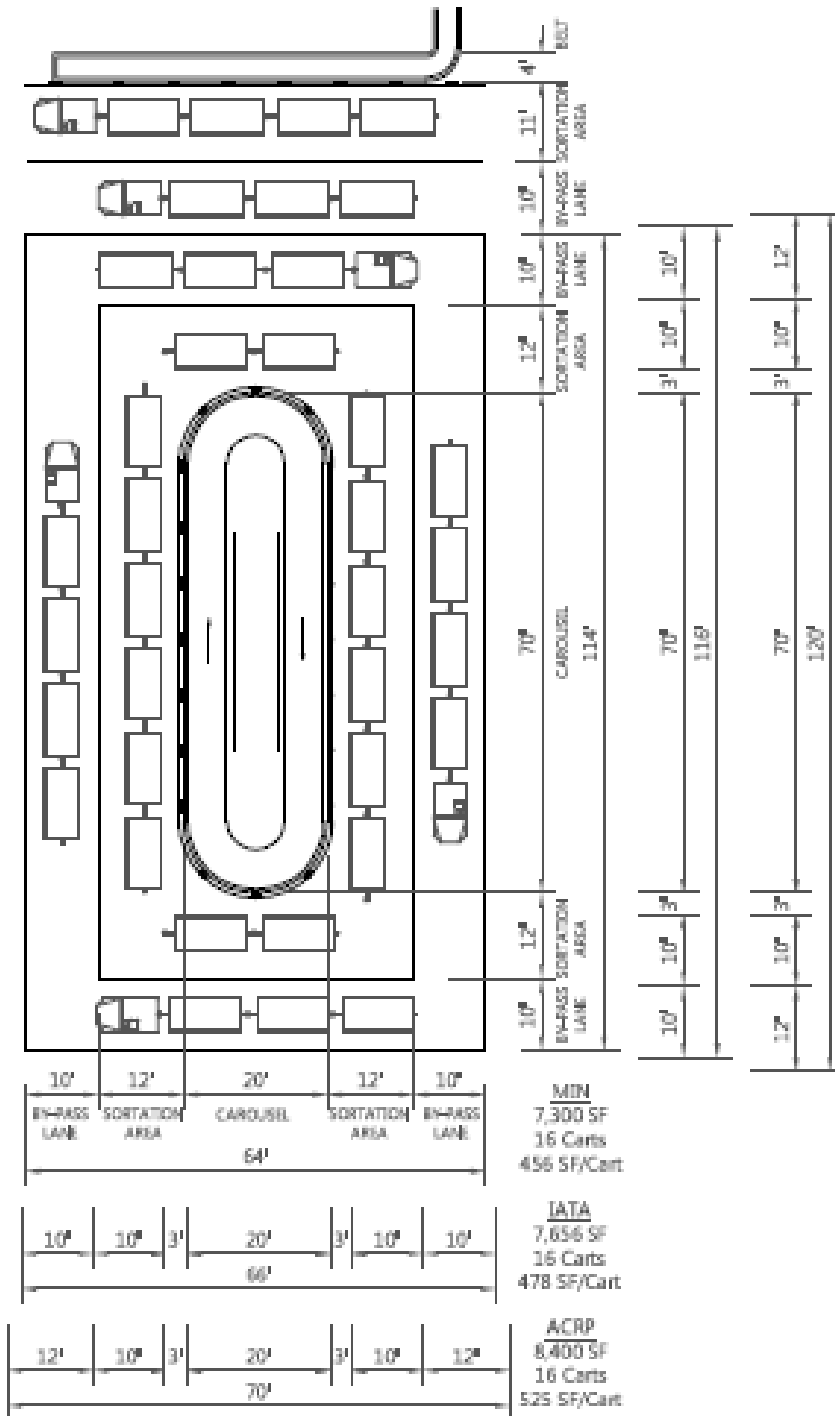


Figure 56: Outbound bag make-up benchmark with parallel staging¹³⁶

¹³⁶ Source: ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, 2010

h. Passenger Security Screening Checkpoints (SSCP)

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.

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)

The Port Authority requires that the number of required processors be calculated based on the maximum waiting times provided in this document. For the calculation of waiting area requirement, sufficient area to accommodate passengers' waiting time of 30 minutes must be provided.

All assumptions related to the percentages of passengers using a specific check-in mode must be documented and approved by the Port Authority. In addition, certain processors may be used by airport employees and must therefore be designed to accommodate that additional demand.

The Port Authority requires the use of IATA ADRM 10 methodology, taking into account the additional requirements stated above, for the calculation of number of processors, waiting areas, and total areas.

Flexible designs that allow for the future expansion of certain functions and contraction of others are necessary to ensure that the terminal building can adapt to future and unforeseen changes in technology and passenger behaviors.

1. Screening Lanes Requirements - Methodology

To assess the required numbers of standard and trusted traveler lanes, the designer must account for the total peak hour demand, percentage of passengers who are in a trusted traveler program (at the time of this writing, varies from 15% - 30% depending on airport), and the lane processing speed of each lane type.

Lane processing speeds vary considerably per airport, and are dependent on many factors, local and national. Designers should consult with local TSA, and perform site surveys if possible, to establish a realistic lane speed for design purposes. At this time of this writing, lane speeds observed at several large airports in the US ranged from 120-180 pax/hr. for standard lanes, and 150-250 pax/hr. for trusted traveler lanes.

Step 1: Calculate the demand from the previous processor.

The demand includes that from:

- The processing desks (CD);
- The self-service kiosks; and
- Those who by-passed the processing desks using web/mobile processing.

Use the following formula: $PK_{30MIN} = (CD * 60 / PT_{CD} * 30) + (BD * 60 / PT_{BD} * 30) + (PHP * PK * (1 - (CR + BR)))$

PK _{30MIN}	=	Throughput 30-minute Demand
CD	=	Number of Service Desks Open
PTCD	=	Process Time for Service at Desks (in seconds)
Cf	=	Correction Factor for Demand Variability (see reference table)
BD	=	Number of Baggage Drop Positions Open
PTBD	=	Process Time at Baggage Drop (in seconds)
PHP	=	Originating Peak Hour Passengers
PK	=	Peak 30-minute Factor (in % of PHP)
CR	=	Ratio of Passengers Using Traditional Check-in Facilities
BR	=	Ratio of Passengers Using Baggage Drops
PD	=	Number of Departure Passport Control Desks
PTPD	=	Process Time for Departure Passport Control (in seconds)
SECi	=	Approximate Number of Security Lanes
PTSEC	=	Process Time per Passenger at Security (in seconds) *
MQT	=	Maximum Queuing Time (in minutes)
A	=	Area Required for the Security Checkpoint Facility
SEC	=	Total Number of Security Lanes
SECd	=	Depth of One Security Lane (in feet). Obtained from typical dimensions
SECw	=	Width of One Security Lane (in feet). Obtained from typical dimensions
QMAX	=	Maximum Number of Passengers Waiting in Queue
SP	=	Space per Person (in sq ft)
W	=	Corridor Width Behind Lanes (in feet) **

* The process time at security is rather a throughput time since the lanes may serve multiple passengers at the same time. The process time is the number of passengers served per period of time, translated into seconds/passenger. For example, if a facility can process an average of 40 persons in 20 minutes, the process time is 30 seconds per passenger.

** The corridor width will vary with the importance of passenger flows. Port Authority minimum standard width is 20 feet for all circulation corridors.

Table 19: Screening lanes calculation inputs¹³⁷

¹³⁷ IATA ADRM 10th Edition

Step 2: Calculate the approximate number of security lanes using the following equation:

$$SECi = (PK_{30MIN} * PT_{SEC} / 60) / (30 + MQT)$$

The maximum waiting times (MQT) to be used for the screening lanes calculation are summarized in the table below:

Port Authority Standard	
WAITING TIME STANDARDS FOR PROCESSING FACILITIES Not To Exceed (Minutes)	
Economy Class	10 min
Fast-Track and TSA pre-check	5 min

Table 20: Waiting time standards for processing facilities

For security checkpoint, waiting time is defined by time when the passenger is entering the queue until the time of arrival at the divestiture table.

These maximum waiting times should be used to determine the number of required processors (security screening lanes) but not for the calculation of space requirements, including sizing of queue areas. The Port Authority requires that queue area be designed to accommodate a 30-minute queue time (see step 4).

Step 3: Adjust requirements to account for variability in passenger arrival distribution within the peak period and in processing time using the following equation:

$$SEC = SECi * Cf$$

Where:

Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)	
For MQT	CF
3, and less	1.22
4	1.22
5	1.15
10	1.06
15	1.01
20	1.00
25	1.00
30	1.00

Table 21: Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)¹³⁸

¹³⁸ IATA ADRM 10th Edition

The smaller the MQT, the greater the variability in demand over the 30-minute period analysis.

Step 4: Calculate the maximum number of passengers in queue using the following formula:

$$Q_{MAX} = 0.495 * \text{Peak 30-min (corresponding to a 30-minute MQT)}$$

Note: When designing a queue area at a security checkpoint facility, the planner should consider a single or snake queue layout. The typical width of a queue at a security checkpoint should be between 4 feet and 4 1/2 feet.

Step 5: Calculate the area required for the security checkpoint using the following equation:

$$A = (\text{SEC} * \text{SECd} * \text{SECw}) + Q_{MAX} * \text{SP} + (\text{SEC} * \text{SECw} * W)$$

The following minimum space per person standards (SP) must be used to calculate the required queuing space for security screening process:

Port Authority Standard	
SPACE STANDARDS FOR QUEUING AREAS (sf/pax) * - MINIMUM	
Economy Class	12.9
Fast-Track and TSA pre-check	12.9

*Considering a queue width of 4.0 feet.

Table 22: Space standards for queue areas

2. Dimensional Criteria

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.

3. Travel Document Check (TDC):

Per the TSA CDG, travel document check (TDC) staffed positions are required at the entrance to the SSCP lanes. When passengers reach the end of the SSCP general queue, TDC officers inspect each passenger's ID and boarding pass. Designers should follow the CDG for number and configuration of TDC positions. Each TDC position requires a standing podium with a boarding pass scanner and ultraviolet (UV) lamp for illuminating UV watermarks on IDs. Each podium must be provided electrical and data connections. Lighting in the TDC area must be adequate and evenly distributed with no harsh glare, so that TDC officers can clearly view the passengers' faces, IDs, and boarding passes.

4. Queuing

At checkpoints with both regular and PreCheck lanes, provide separate queuing for regular and PreCheck passengers. As part of the incentive for passengers to participate in the PreCheck program, there is an expectation of lower wait times for PreCheck queuing.

Where an airline or terminal operator has overall control over the queuing of a checkpoint, they may wish to provide special queuing for premium passengers. This queue is expected to be substantially shorter than the queue for economy passengers, due to smaller demand population. Because premium passengers may or may not be enrolled in PreCheck, if a checkpoint has both regular and PreCheck

lanes, the premium queue should be positioned between the regular queue and the PreCheck queue, so that premium passengers may be directed by the TDC to either regular or PreCheck lanes.

5. Screening

i. Passenger Screening

Typical configuration with one X-ray unit for each Walk-Through Metal Detector (WTMD) varies from approximately 27 to 31 feet wide for a pair of lanes, depending on the type of baggage X-ray unit used. If a “2 to 1” configuration of two X-rays for one WTMD has been installed, a slightly narrower footprint of approximately 22 to 29 feet can be assumed. Non-standard configurations are also used when physical constraints do not allow a typical line of inspection lanes. Additional width may be associated with ADA accessible lanes¹³⁹.

¹³⁹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.3.2, 2010

The following figure shows the minimum dimensions for security screening lanes:

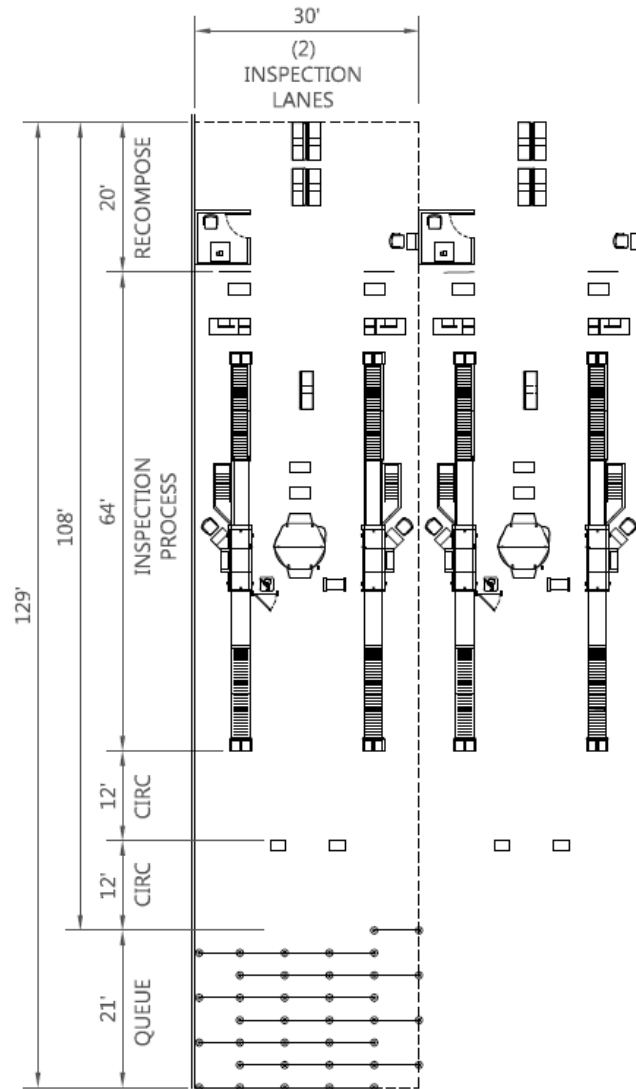


Figure 57: Minimum dimensions for security screening lanes ¹⁴⁰

For additional information on the kind of equipment to use, it is advisable to follow the dimensions shown in the TSA Checkpoint Design Guide Revision 5.1 (2014). This manual provides all the dimensions for the different components of the lanes according to each type of equipment and WTMD.

ii. Carry-on Bag Screening

The length of the SSCP varies depending on a number of factors but is primarily related to the length of the tables placed before the X-ray unit for passengers to unpack laptop computers, take off jackets and shoes, and remove metal objects from pockets. Similarly, the length of roller beds and/or tables, and seats after the SSCP for passengers to put clothing back on and repack bags, can vary. Airports are experimenting with these functions, and standards for these tables are evolving. The length for an SSCP

¹⁴⁰ Source: TSA guidelines

can vary from 57 to 68 feet. The variability in both SSCP width and length is a function of the type of baggage X-ray unit, the type of passenger holding and/or wandng stations, and other screening equipment¹⁴¹.

The dimensional guideline for a checkpoint lane pair with AIT and magnetometer is approximately 3,870 square feet. 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.

Refer to Part 2, Section h.

Regarding Automatic Screening Lanes, TSA Innovation and Concept Supplemental Information 1-2010 v.1 provides layouts and dimensions of different examples of ASL.

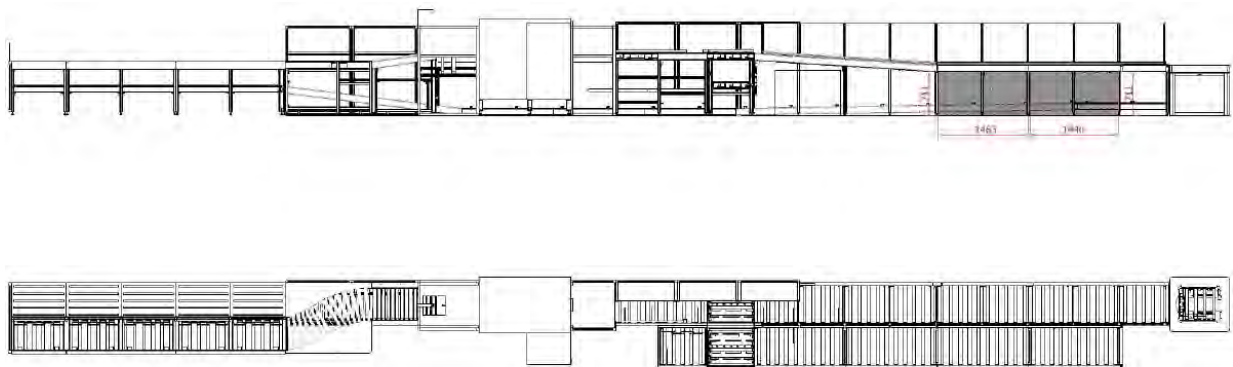


Figure 58: ASL Example – SmartView MacDonalld Humfrey LTD

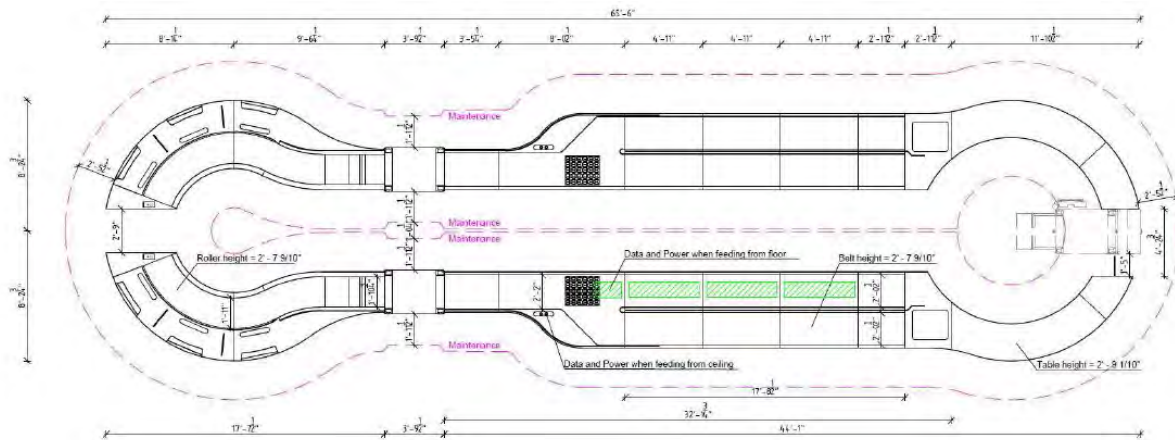


Figure 59: ASL Example – Scarabee

¹⁴¹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.3.2, 2010

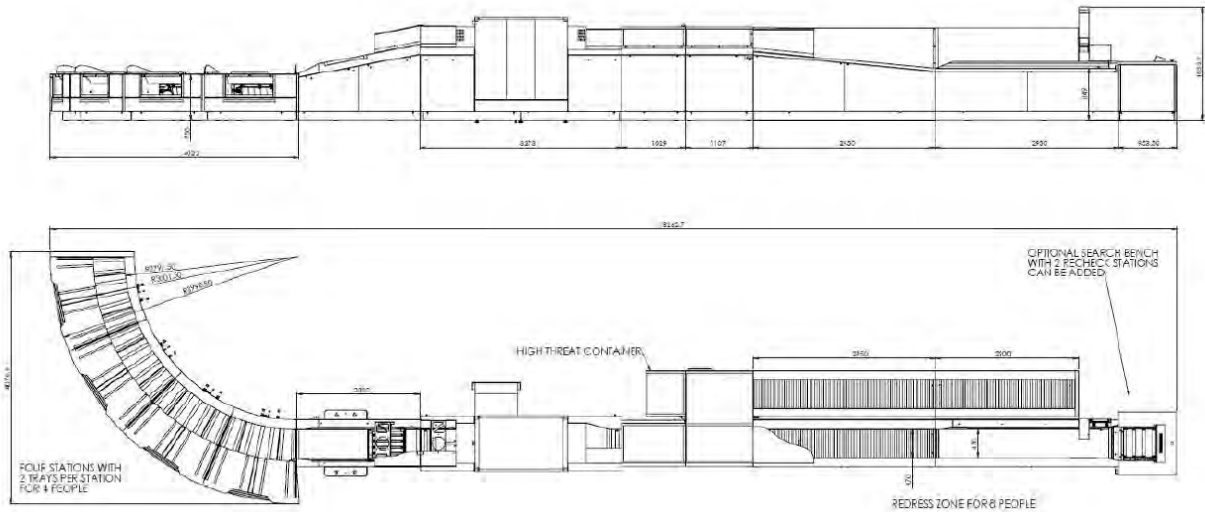


Figure 60: ASL Example – SCANNOJET Vanderlande Industries

iii. Trusted Traveler, TSA PreCheck, and Clear

TSA Checkpoint Design Guide Revision 5.1 (2014) 3.2.1 provides layouts with different security screening lane configurations that include PreCheck lanes.

The main purpose of implementing trusted traveler lanes is that they process passengers at a faster rate than standard lanes, because less divestiture is required – passengers do not need to remove shoes and belts, and do not need to take laptops or liquids out of their carry-on bags. Passengers are therefore incentivized to join a trusted traveler program, because their experience at the SSCP will be faster and simpler.

Operational requirements must be met in order to expand one or more lanes to PreCheck at a given checkpoint. Requirements include¹⁴²:

- Sufficient predicted or realized volume for sustained periods to open a new lane or expand to an adjacent lane
- Designs are managed by an RBS coordinator
- PreCheck lane is operated with an AT2 X-ray and CEIA WTMD
- Sufficient personnel are trained and available to run additional PreCheck lanes as necessary
- Ability to restrict non-PreCheck passengers from accessing the PreCheck lane
- Maintain a minimum of one standard lane operating within the checkpoint
- If implementing a dual use lane, provide a visible indicator for TSOs to identify mode of operation (PreCheck Standard)

¹⁴² TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 3.2.1, 2014

Depending on the airport configuration and which airlines are increasing in volume, there are three options which an airport may expand their PreCheck lane:

- Option 1: Move an existing PreCheck lane to better accommodate traffic patterns and expansion
- Option 2: Add a new PreCheck lane at a new checkpoint that previously did not have sufficient volume
- Option 3: Expand existing PreCheck to an adjacent lane (either full-time or part-time as “Dual Use”)

Due to a variation of PreCheck demand at certain times, the checkpoint can be configured to allow for flexing screening lanes. If at least one PreCheck lane is currently operational, the checkpoint is capable of expanding to additional lanes as needed. With equipment layout and queue planning, limited reconfiguration and time is required to “flex” from one PreCheck lane to additional lanes.

iv. Secondary Search

Secondary screening is typically located in the “dead” operator space on back-to-back lanes or at the end of the lane for odd numbered lanes. This area should be clear of exiting passengers. The secondary screening area typically consists of Explosive Trace Detection (ETD) unit, a Bottle Liquid Scanner (BLS), an Alternate Viewing Station (AVS) (only provided in AT2 which represents the second deployment of the AT units which consists of the Rapiscan 620DV, the Smiths 6040aTiX, and the L3 ACX 6.4-MV), a Mobile Cabinet, a search table and a passenger search chair and mat. The area is approximately 3’-0” to 5’-0” from the end of the screening lanes in order to minimize travel time and the distance that TSOs have to carry bags.¹⁴³

For the passenger search position TSA guidelines consider that the area comprising the inspection search and the mat should be 6’-0” by 6’-0”, in order to be able to accommodate passengers in wheelchairs and that passengers will be able to maintain eye contact with their belongings.

v. VIP Screening

Depending on the number and type of VIPs the airport is likely to handle, facilitation/processing may be done in dedicated standalone VIP facilities/buildings or handled through the passenger terminal assuming that appropriate controls are in place. Careful consideration is required when planning these facilities and airports and planners should seek inputs from government and local regulatory authorities to better understand the possible threats and needs¹⁴⁴.

When calculating demand levels for the SSCP, VIP demand cannot get subtracted from peak demand for general passengers. VIP lanes are voluntary by developer / airline.

¹⁴³ TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 2.5, 2.6 & 2.12, 2014

¹⁴⁴ IATA ADRM 10th Edition, Section 3.4.11.12.3e, 2017

vi. Known Crewmember (KCM)

Planners should carefully consider the location for security screening of air crews. Where possible, dedicated checkpoints, or those combined with staff screening, will often make the most operational sense¹⁴⁵.

vii. Private Screening

Private Screening Room (PSR) is approximately 6'-0" by 8'-0" (minimum dimensions) with 8'-0" high glass panels and a 3'-0" door on either the short wall (S3) or the long wall (S3-A). Larger private screening rooms of 8'-0" x 8'-0" or greater is optimal.¹⁴⁶ The private screening room (or booth) should meet ADA accessibility standards.

Due to the relatively infrequent utilization, normally one private screening room or booth per checkpoint is sufficient. More may be required at large, high-volume checkpoints, or where experience has shown that a high percentage of private searches occur. Verify requirements with local TSA officials.

viii. Recomposure

TSA provides composure benches approximately 14'-0" from an AIT depending on the equipment arrangement. This area is typically out of the main passenger flow.¹⁴⁷

Additional benches and tables beyond those recommended in the TSA CDG should be provided to improve the passenger experience and the lane throughput rate. The numbers, types, and configuration of furniture will be dependent on available space, and the degree to which the terminal management wishes to provide additional non-revenue space to improve lane rates and passenger experience.

i. Post-Security Area / Concourse

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. Information used to develop concourse gate requirements include:

1. Circulation Area

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

¹⁴⁵ IATA ADRM 10th Edition, Section 3.4.11.12.3d, 2017

¹⁴⁶ TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 2.11.1, 2014

¹⁴⁷ TSA Checkpoint Design Guide (CDG) Revision 5.1, Section 2.13, 2014

Port Authority Minimum Circulation Corridor Width (feet)		
	Concourse Configuration	
	Single Loaded Concourse	Double Loaded Concourse
Circulation Corridor Width (feet)	20	30

Note:

Minimum clear corridor widths above are required in addition to moving walkways, if provided.

For double loaded corridors with centrally located moving walkways, a minimum width of 15 feet should be provided on both sides of the walkways. Additional corridor width may be required for high-volume hub terminals, corridors with potential use of electric carts.

Table 23: PA Minimum Circulation Corridor Width

The procedure for calculating the circulation areas¹⁴⁸:

- Describe the design passenger flow per hour for travel in one direction and convert into passenger flow per minute.
- Calculate the required effective width.
- Adjust the required effective width to account for edge effects. Total (net) width equals to effective width plus 1.5 feet on each side of corridor.

If circulation facilities allow movements in both directions, use total passenger flows for both directions for step 1 and adjust total width by adding 1.5 feet for each side of corridor plus another 1.5 feet for counter-flow effect.

The program area is usually based on a percentage of the other public areas of the terminal and typically ranges from 15% to 30% of these areas. The percentage is a first approximation and will also vary with the terminal configuration and gross size of the terminal. The split between secure and non-secure (public) circulation is also a function of the terminal concept¹⁴⁹.

Moving walkways are recommended when passenger walking distances are long (exceeding 1,000 feet) and should be located to allow access to gates and concessions¹⁵⁰.

Moving walkways are available in different widths, designated by the width of the pallet passengers stand on. The minimum pallet width for an airport is 48 inches, but 56-inch pallets allow passengers with roller cases to easily pass other passengers without interference. Depending on the manufacturer, a 48-inch walkway is approximately 5 feet 10 inches in overall width and a 56-inch walkway is approximately 6 feet 6 inches wide.

2. Holdrooms

i. Methodology for Holdroom Area Requirements

Holdrooms are to be sized to accommodate the number of passengers on the largest aircraft of an aircraft design group that can be parked at each gate. Concessions, lounges and circulation areas may not be classified as “Holdrooms.”

¹⁴⁸ IATA ADRM 10th Edition, Section 3.4.6.1.3, 2017

¹⁴⁹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.10.4, 2010

¹⁵⁰ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.10.6, 2010

Requirements are calculated based on a percentage of total passengers who could be at the gate at a given time. In recent years, airports and airlines have been attempting to minimize capital expenditures and operating costs. Space requirements for departure lounges are increasingly being determined based on: (a) assumptions regarding flight schedules, (b) shared space among adjacent gates, and (c) the percentage of passengers who wait for flights in adjacent concession areas¹⁵¹.

Based on the methodology described above, the following tables provide minimum PANYNJ holdroom area and holdroom seating requirements by aircraft design groups.

The following sizes are to be considered as minimum:

Port Authority Minimum Standards				
	Stand-alone Holdroom		Shared Holdroom	
	Holdroom Seats	Holdroom Area	Holdroom Seats	Holdroom Area
Group III	123	3,300	111	3,000
Group IV	155	4,100	140	3,800
Group V	257	6,600	232	6,200
Group VI	354	8,800	319	8,200

Table 24: Holdroom requirements

ii. Dimensional Criteria

Areas used as gate holdrooms must have the following characteristics:

- Clear sight of the Boarding Podium
- Not more than 125 feet from the Boarding Podium¹⁵²
- Good quality public address (PA) system for agents at each Boarding Podium to make announcements to passengers in the holdroom
- Not more than 300 feet from the closest Restroom

It is desirable to have natural light through windows and or skylights, and to have a view of the apron and in particular the aircraft associated with the holdroom. It is desirable to have power outlets (standard and USB) for at least 25% of the passenger population of largest aircraft served by the holdroom. Criteria for shared holdrooms can be found in Part 1, Section 4.

¹⁵¹ FAA AC 150/5360-13A, Section 6.4.1, 2016 (Draft)

¹⁵² Criteria currently under review by the Port Authority and subject to change

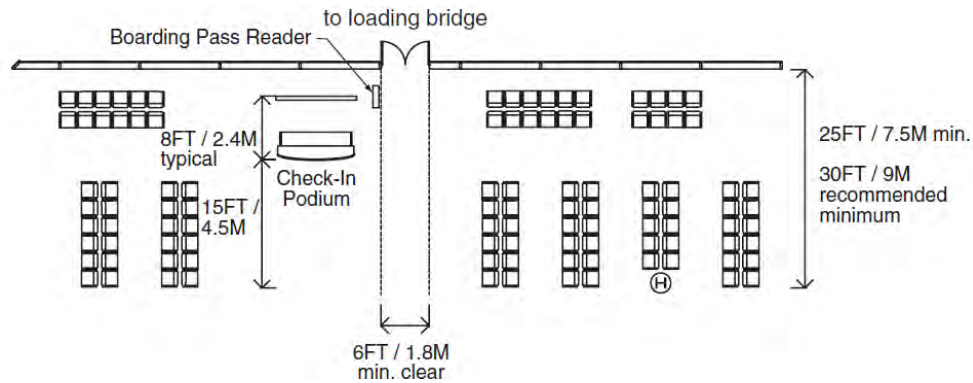


Figure 61: Holdroom schematic ¹⁵³

3. Concessions

When planning for concession space, it may be useful to benchmark the estimated space against such space at other airports and contact peer (comparable) airports to discuss their planning standards. In setting planning standards, such factors as the following should be taken into account for designing the concession areas¹⁵⁴:

- The efficiency of a terminal in terms of concentrating passenger flows
- Exposure to passengers
- The allocation of space pre- and post-security to reflect customer demand
- Configuration of the space in terms of frontage and depth preferred by concessionaires
- Passenger/customer characteristics
- Clustering of concessions to create desirable retail density

Next section provides the Port Authority guidelines for concession space requirements computation. As the needs and requirements for each terminal development may vary from one project to another, the calculation methodology, assumptions and results should be submitted to the Port Authority for review at the early stages of the planning process.

i. Methodology for Concession Space Requirements

Normally such calculations do not include seating, public toilets, circulation or other areas. Generic formulas usually take into consideration the following¹⁵⁵:

- Busy Hour Rate (from design day flight schedule)
- Penetration is based on the size of the commercial unit (depth times shop front width). For a typical unit, a maximum depth of 33 feet is advised. For a larger unit with a wider shop front, the depth can be increased;
- Dwell time is the time that passengers spend in the concessions area and differs for Domestic, International and New Model terminals;

¹⁵³ Source: ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.4.3, 2010

¹⁵⁴ ACRP Report 54, Resource Manual for Airport In-Terminal Concessions, Chapter 11, Section 5.1.7, 2011

¹⁵⁵ IATA ADRM 10th Edition, Section 3.4.14.1.6, 2017

- Time spent on shopping, eating and other activities is an estimate based on data collected for that specific airport, but can be altered depending on the concessions offered; and Commercial revenues are often an important source of financing for airport operations, maintenance and infrastructure development. According to IATA, some larger airports, up to 20 percent of the terminal area may be dedicated to retail shops and other concessions, although from 8 to 15 percent is more typical¹⁵⁶. An important step in determining the amount of supportable space is forecasting spend rates per enplaned passenger by concession category: food/beverage, convenience retail, specialty retail, and duty free.

While every airport will be different based on its passenger profile, the Port Authority recommends the use of the following ratio for preliminary planning, in line with the most recent IATA guidelines¹⁵⁷ with the objective to achieve world class service. This ratio is based on an international terminal configuration. Domestic terminal planning may have some variation and will be considered on a case by case basis:

- For new construction minimum concessions floor space: 13.0 ft² x each 1,000 annual enplaned passengers.
- For existing terminals concessions program redevelopment, the minimum concessions floor space standard of 13.0 ft² x each 1,000 annual enplaned passengers is recommended, provided the space is available for commercial development.

This ratio should be customized carefully depending upon the overall concessions planning concept (i.e., whether concessions are concentrated in specific zones or dispersed throughout the terminal). The type of activity occurring in any zone within the terminal will influence the type and amount of concessions space required for that zone.

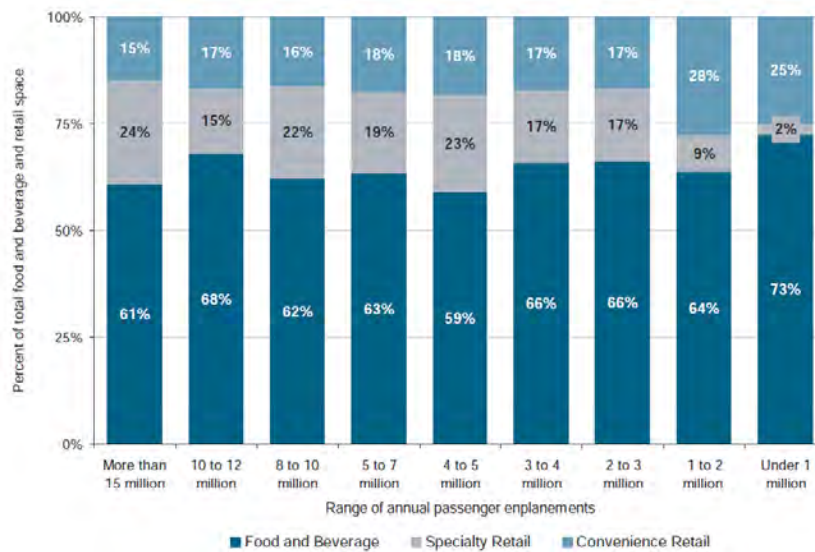


Figure 62: Percentage of space by major concession category ¹⁵⁸ (for comparison purposes only)

¹⁵⁶ IATA ADRM 10th Edition, Section 3.4.14.1.4, 2017

¹⁵⁷ IATA ADRM 10th Edition, Section 3.4.14.1.5, 2017

¹⁵⁸ ACRP Report 54, Resource Manual for Airport In-Terminal Concessions, Chapter V, Section 5.1.4, 2011

In addition, the Port Authority recommends the following ranges in terms of concession space allocation between pre-security and post-security areas:

Concession Location	Percentage of Concession Space
Pre-Security	10-20%
Post-Security	80-90%

Table 25: Percentages of concession spaces and sales based on the location within the airport

In order to provide a stellar customer experience, the Port Authority requires the provision of Food & Beverage concessions in all terminal pre-security areas. Special Consideration should be given to meter greater areas at the Arrivals Level.

j. Airline Customer service

The decision of whether or not to provide a dedicated airline customer service station post-security is up to the individual airline(s) operating at the terminal. The airline(s) should be consulted directly for requirements.

k. Premium Lounges

The size and number of lounges at an airport is highly dependent on the airline mix and passenger volume. Airlines within alliances have joined together at some airports to provide a single lounge for all of the alliance’s passengers. This consolidation has reduced, in some cases, the total lounge area that would be required by the individual airlines, while providing their passengers with more services¹⁵⁹.

l. Nursing rooms

Each concourse should have a nursing room, separate from a restroom or family room, with a locking door or controlled entry, electrical power available, a sink and countertop, a baby changing station, soap, paper towel dispensers, and comfortable seating as minimum amenities. Pending legislation proposed to Congress may mandate that airports provide lactation rooms as noted in ACRP Report 157.

The objective is to establish rooms for a single or multiple user with optimum flexibility for nursing mothers and equipment such as strollers and carryon luggage.

m. Water filling stations

Water filling stations should be provided with each restroom bank and one additional for every three holdrooms. Planners should check policy versus water sales and local plumbing codes.

¹⁵⁹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.11.4, 2010

n. Children’s Play Areas

In order to increase the level of service and the passenger experience, many airports are incorporating children’s play areas besides the holdrooms. The children should always be under adult supervision. One children’s play area should be provided at least per 10 holdrooms.

o. Pet Relief Areas

The number of Service Animal Relief Area (SARAS) installations at the airports is incrementally increasing in response to the growing number of passengers accompanied by emotional support animals (ESA’s) and officers on duty with law enforcement dogs. There are currently nine SARA’s within the PANYNJ Airport System. On the non-secured side pet relief areas can be provided outdoors near the curbside. On the post-security side, provide at least one pet relief area per post-secure concourse. Additional locations may be provided based on the size or configuration of the sterile area.

Basic performance criteria are articulated in FAA Circular AC 150/5360-14A Appendix A, including “The SARA may be constructed in any shape, but the minimum size of a SARA should provide adequate space to accommodate a person using a wheelchair handling a service animal secured on a five-foot leash” and large enough for the animal to circle its handler (approximately 60 sq. feet). “In busier locations, a relief area may be sized to accommodate more than one service animal at one time.”

p. International Arrivals

It is recommended to follow CBP regulatory requirements in Airport Technical Design Standards. These documents 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.

1. Sterile Corridor

The sterile corridor should be sized based on peak period demand. Where long walking distances are required, provide moving walkways.

It is recommended that a minimum width of 6-8 feet for each gate’s deplaning corridor leading from the passenger boarding bridge to the sterile corridor. Because passengers from multiple simultaneously arriving aircrafts may use the sterile corridor, its width is similar to a concourse circulation corridor, but it may be somewhat less wide because passengers are all flowing in one direction only – towards the FIS¹⁶⁰.

2. International In-Transit Lounge for Passengers Not Entering the US

Currently the PANYNJ does not provide this facility.

3. Immigration (Conventional Option)

CBP primary facilities are sized for a capacity stated in terms of passengers per hour. This rating is “steady state,” assuming a relatively well-distributed pattern of arriving flights.

¹⁶⁰ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.4.3, 2010

i. Processing Elements and Space Calculation

The number of booths required for primary inspection is typically prescribed by the CBP based on the design hour passenger volume and, as such, consideration of dynamic issues will not usually impact that aspect of the facility. However, while agencies may specify minimum queue depths, they may be insufficient depending on the likely distribution of peak hour passengers amongst flights and the relative timing of those flights. Examining demand in a smaller time frame, 15 or 30 minutes, is often helpful in understanding the maximum length of queue to be accommodated. One other key area to consider in arrivals facilities is the impact of off-time (i.e., early or late) flights. In addition to a base analysis, if off-time data is available, a number of sensitivity tests should be performed to fully understand the dynamics of the facility¹⁶¹.

The FIS/CBP model is designed to estimate the passenger queue lengths, space requirements, and passenger delay time for primary processing; baggage claim requirements; and the time baggage claim devices will be in use. Among the many CBP facility requirements is the number of double inspection booths and the minimum passenger queue depth and width for primary inspection. This spreadsheet model allows the user to evaluate a CBP-recommended passenger flow rate and booth count, or user-selected values.

34	SINGLE ARRIVAL - PRIMARY PROCESSING EXAMPLE	INPUTS	OUTPUTS	EXAMPLE #2
35	# of Seats on Arriving International Flight	400		
36	Load Factor of Arriving Flight	80%		
37	# of Arriving Passengers on sample flight		320	
38	Existing # of Double Booths	6		
39	User Specified # of Double Booths	4		
40	Total Primary Processing Positions		8	
41	Unload Rate (Passengers/min)	20		
42	Primary Processing Rate (Passengers/Hr/Double Booth)	100	CBP suggests 100 Pax/Hr/Double Booth	
43	Choose the bucket size for the Mini Queue Model to use	5 Minute	<--MAKE SELECTION	
44	Max # of Passengers in Queue		200	
45	Average wait time in Queue (min.)		15.9	
46	Max wait time in Queue (min.)		30.0	
47	Throughput Rate to Baggage Claim (Passengers/min)		6.7	
48	Width of Double Booth (ft.)	11.5	11.5 ft is standard	
49	Desired Passenger Space in Queue (sq. ft/ pax)	15.0		
50	Queue Model - Queue Area for Primary Processing (sq. ft)		3,000	
51	Queue Model - Queue Depth (ft.)		43	

Figure 63: Sample calculation screen for FIS requirements ¹⁶²

It is recommended to follow CBP regulatory requirements in Airport Technical Design Standards. These documents 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.

¹⁶¹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.2, 2010

¹⁶² Source: ACRP Report 25, Vol 2, Airport Passenger Terminal Planning and Design, Federal Inspection Services/U.S. Customs and Border Protection Model, 2010

ii. Dimensional Criteria

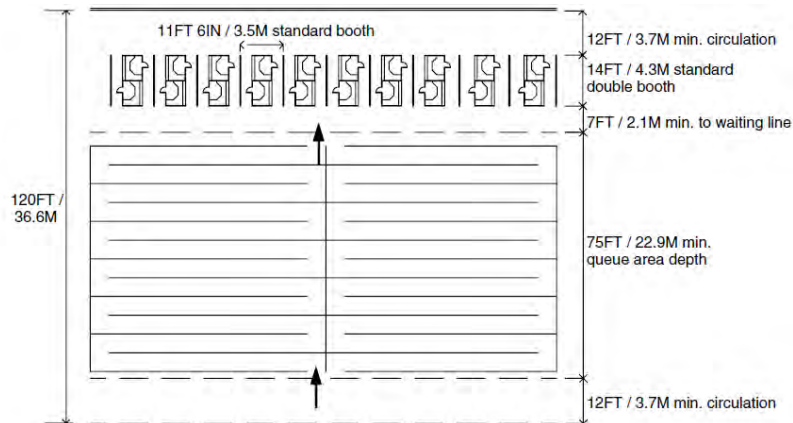


Figure 64: Schematic for FIS queue design¹⁶³

iii. Immigration (Automated Primary Option)

In this new protocol, all passengers utilize kiosks for primary (immigration) screening. The number and arrangement of kiosks should be determined based on peak period demand, average transaction times, and equipment failure rates. In general, it is expected that queuing here would be minimal, while queuing for the single agent check at the end (formerly customs only, now immigration plus customs) would be more substantial.

If the Automated Primary option is implemented, all passengers will utilize a kiosk for the initial primary (immigration) step in the CBP process. The number and arrangement of kiosks will be based on the peak period demand, processing rates, and percentages of passengers in each CBP processing classification (Global Entry / other expedited, US citizen standard, visitors)

At the time of this writing Automated Primary is an emerging protocol. Designers should consult with CBP to discuss specific requirements.

iv. International Bag Claim System

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

¹⁶³ Source: ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.2, 2010

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. Because passengers may be delayed at immigration, the claim rate may be low, or zero, in case of extreme delays.
- Level of service criteria
- Dimensional criteria (space template)

v. Processing Elements and Space Calculation

The analytical approach presented below is based on the latest IATA ADRM guidelines and captures an ideal scenario, where the first passenger arriving and the first baggage arrive at the reclaim belt on the same time. Coordinating the arrival of bags on the carousels and that of the passengers in the hall minimizes facility requirements. However, this ideal situation is difficult to encounter.

The requirements from the following analytical approach should be supplemented with terminal passenger flow simulations, to account for additional requirements arising from the time difference between first passenger and first bag. In addition, the following approach does not account for additional passenger circulation area around the bag claim, which should be assessed via simulation.

CL _(NB/WB)	=	Carousel frontage for passenger line up (in feet)
PAX _(NB/WB)	=	Number of passengers in the design aircraft (Narrow Body/Wide Body)
SP	=	Claim frontage per passenger (ft)
PR	=	Ratio of passengers collecting bags
RR	=	Recirculation rate. Percentage of bags that will recirculate on the carousel using up space and preventing other bags from joining the carousel (in %). This number should be adjusted based on aircraft size (narrowbody/widebody), flight origin (international/domestic) and layout specific conditions.
BC _(NB/WB)	=	Number of Narrow Body/Wide Body baggage claim units
PHP	=	Peak hour number of terminating passengers, international/domestic transfer passengers, where applicable
P _(NB/WB)	=	Proportion of passengers arriving by narrow body/wide body aircraft.
OT _(NB/WB)	=	Average claim device occupancy time per narrow body/wide body aircraft (minutes) or assume 20 minutes for narrow body and 45 minutes for wide body
AC _(NB/WB)	=	Area of a carousel for narrow body/wide body aircraft
Cw	=	Carousel width (ft)
SB	=	Side buffer to allow passenger movement around the reclaim belt (total feet, allowing for both sides)
EB	=	End buffer to allow passenger movement around the reclaim belt (total feet, allowing for both sides)
A	=	Area of the baggage reclaim hall (sq ft)

** The corridor width will vary with the importance of passenger flows. Port Authority minimum standard width is 20 feet for all circulation corridors.

Table 26: International baggage claim calculation inputs¹⁶⁴

Step 1: Determine the claim frontage length required to accommodate passengers from a specific aircraft served by the reclaim area. Please note, it is recommended to accommodate even the largest flight on one belt, to avoid splitting a flight onto two carousels.

Determine the claim frontage length required using the following formula:

$$CL_{(NB/WB)} = PAX_{(NB/WB)} * SP * PR * RR$$

¹⁶⁴ IATA ADRM 10th Edition

Port Authority Standard	
SPACE STANDARDS FOR WAITING AREAS (lf/pax) - MINIMUM	
Baggage Claim (SP)	2.0

Table 27: Port Authority minimum space standards for baggage claim waiting areas

Only passengers who have to collect bags at the airport should be included in the calculation.

Step 2: Determine the number of baggage claim devices using the following formula:

$$BC_{(NB/WB)} = (PHP * P_{(NB/WB)} * OT_{(NB/WB)}) / (60 * PAX_{(NB/WB)})$$

Note: The number and size of baggage claim devices will depend on various additional factors such as flight / airline assignment strategy and specific flight schedule characteristics. The baggage claim requirements from the analytical approach should be confirmed with the flight schedule, and increased as required.

Step 3: Determine the baggage claim area:

$$AC_{(NB/WB)} = (BDC_{width} + SB) * ((CL_{(NB/WB)} / 2) + EB)$$

This calculation should be repeated for all the different kinds of carousels (i.e., for wide body, narrow body aircraft). This is a generic calculation considering linear double-sided carousels. Different shapes will have different geometric calculations and possibly improved area requirements.

Step 4: Once we have the area for the different types of carousels:

$$A = BC_{NB} * AC_{NB} + BC_{WB} * AC_{WB}$$

Note (Additional Design Goals from IATA ADRM guidelines): the time between first passenger arriving at the reclaim belt and the first baggage arriving on the reclaim belt should be zero minutes, to maximize the efficiency of checking a hold bag for the passenger. The maximum time for delivery of the last bags of all flights should not be more than the time of the first passenger arriving at the reclaim belt plus:

- 30 minutes for narrow body aircraft flights
- 45 minutes for wide body aircraft flights

vi. Dimensional Criteria

The following figures provide layouts and dimensions of different baggage claim carousels configurations.

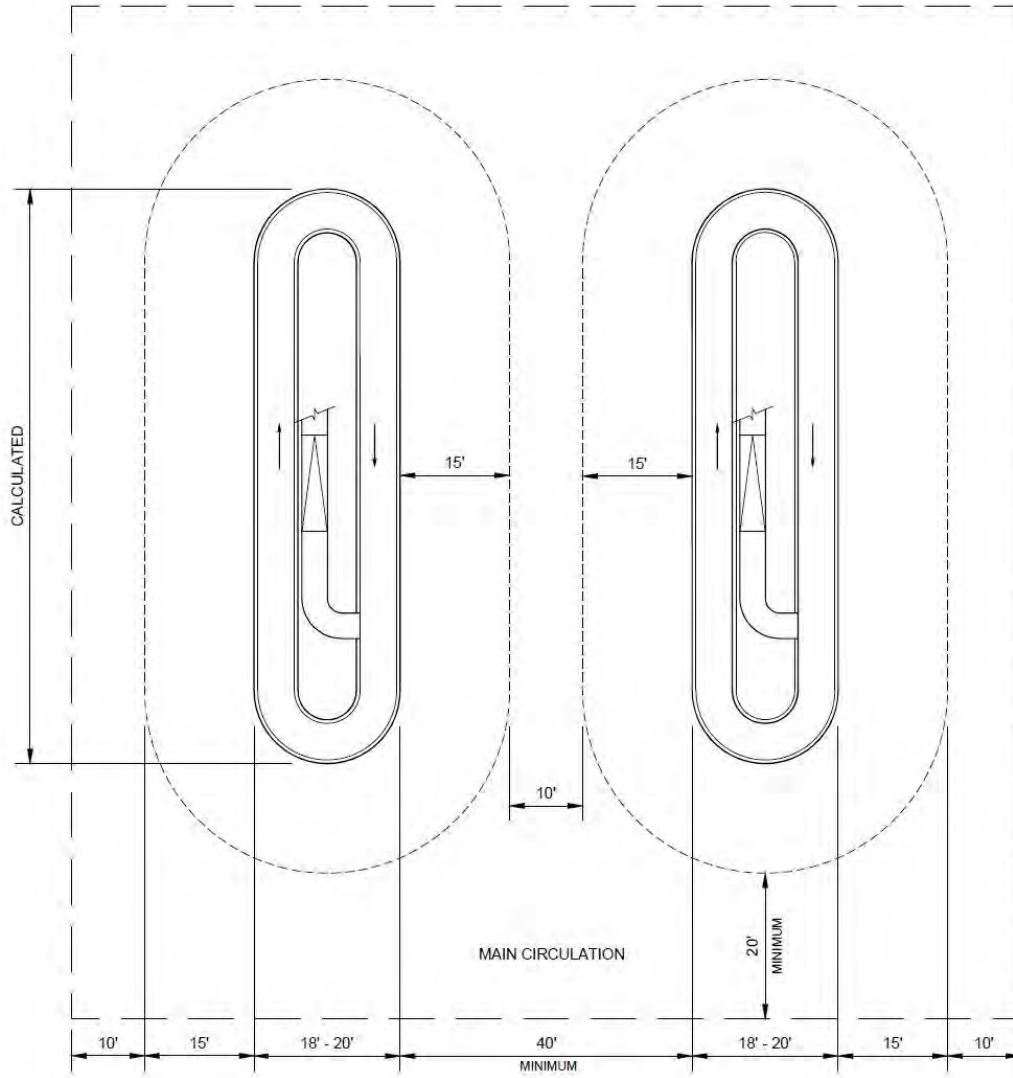


Figure 65: Round carousel schematic ¹⁶⁵

¹⁶⁵ Source: Port Authority of NY & NJ

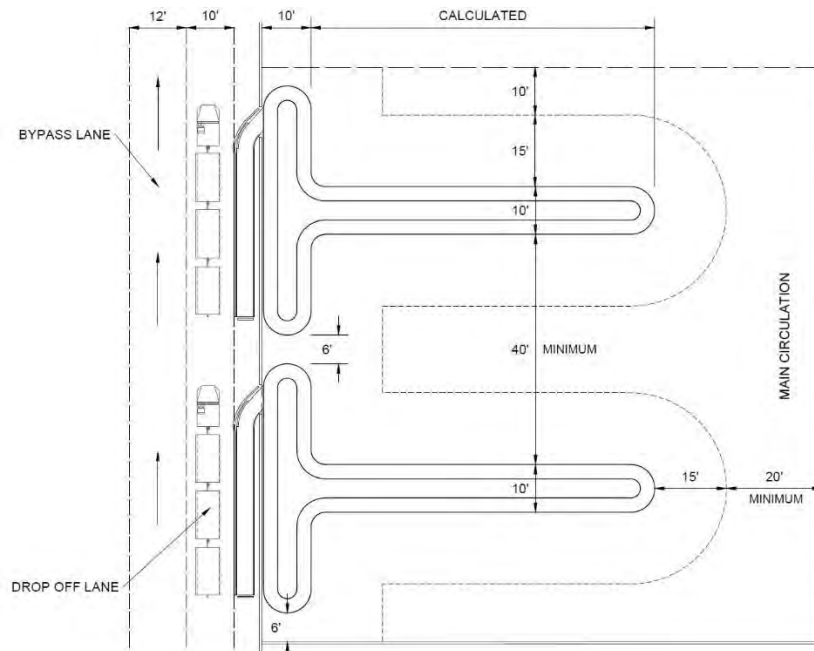


Figure 66: T-carousel schematic ¹⁶⁶

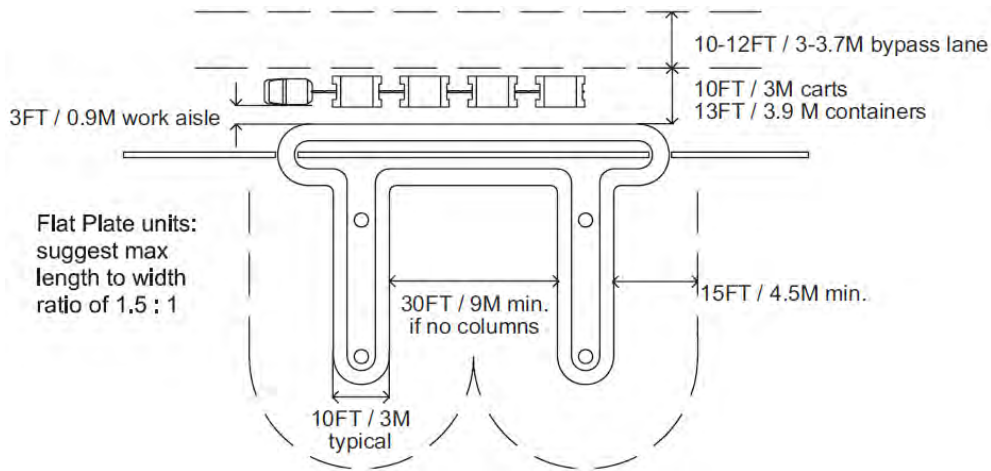


Figure 67: Flat plate carousel schematic ¹⁶⁷

4. Airline Baggage Service Office

Area requirements for Baggage Service Office (BSO)s are highly airport specific but should be based on the number and market share of airlines and O&D passengers¹⁶⁸.

¹⁶⁶ Source: Port Authority of NY & NJ

¹⁶⁷ Source: ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.7.3, 2010

¹⁶⁸ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.11.2, 2010

5. Baggage Carts

Baggage carts can be considered both an amenity and a revenue source. Whether provided free as a passenger service or for a fee, the following factors should be considered when planning the terminal¹⁶⁹:

i. Location and distance

The further a passenger needs to move his checked baggage, and the more bags there are, the more likely a passenger will want to use a cart. Thus, typically parking garages will generate more demand than curbside locations for departing passengers, and international baggage claims will generate more than domestic baggage claims.

ii. Space

Although carts are nested for storage, the area can become significant if demand is high and there are large surges of demand such as a peak arrivals bank of flights. Locating cart racks or staging areas should be considered in the planning process to avoid the carts becoming choke points in baggage claim areas and circulation corridors.

iii. Cart management

Typically, a third party will be responsible for cart operations. This responsibility includes picking up carts from around the terminal and adjacent parking areas and redistributing them to the locations where passengers need them. Terminal plans need to consider that long strings of carts will be moving to these locations and that ramps, doors, and other access points need to be planned to minimize conflicts with people and vehicles.

6. Customs

It is recommended to follow CBP regulatory requirements in Airport Technical Design Standards. These documents 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.

¹⁶⁹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.6, 2010

i. Processing Elements and Space Calculation

PI	=	Number of Primary Inspection Booths (single units)
PHP	=	Terminating Peak Hour Passengers
PK	=	Peak 30-minute Factor (in % of PHP)
$PT_{(PI/XR)}$	=	Process (throughput) Time per Passenger at Primary Inspection Booth/X-ray Facility (in seconds)
XR	=	Number of X-ray units
IR	=	Ratio of passengers to be inspected
Pld	=	Depth of One Primary Inspection Booth Lane
Plw	=	Width of One Primary Inspection Booth Lane
$MQT_{(PI/XR)}$	=	Maximum Queuing Time at Primary Inspection Booth/X-ray Facility (in minutes)
$A_{(PI/XR)}$	=	Area Required for the Primary Inspection Booth/X-ray Facility
XRd	=	Depth of One X-ray Lane (in feet).
XRw	=	Width of One X-ray Lane (in feet). Includes X-ray Equipment, Circulation and Operator Position
Q_{MAX}	=	Maximum Number of Passengers Waiting in Queue
SP	=	Space per Person (in sq ft)
W	=	Corridor Width Before/Behind Desks (in feet) *

* The corridor width will vary with the importance of passenger flows. Port Authority minimum standard width is 20 feet for all circulation corridors.

Table 28: Customs calculation inputs¹⁷⁰

When there is specific need for all arrival passengers to be processed by a customs agent on exit from the reclaim area, follow steps 1 to 3.

Step 1: Calculate the number of customs check positions using the following equation. It is considered that all passengers go through this facility when in place.

$$PI = ((PHP * PK * PT_{PI} / 60) / (30 + MQT))$$

Step 2: Calculate the maximum number of passengers in the queue

$$Q_{MAX} = 0.495 * \text{Peak 30-min (corresponding to a 30-minute MQT)}$$

Step 3: Calculate the area required for the customs check facility.

$$API = (PI * Pld * Plw) + Q_{MAX} * SP + (PI * Plw * W)$$

Actual search facilities for customs can be estimated using the following equation, but should be verified with specific local border/custom requirements (i.e., proportion of passengers searched or type of check/search).

Step 4: Calculate the number of X-ray units required using the following equation.

$$XR = [(PHP * PK * IR * PT_{XR} / 60) / (30 + MQT)] * Cf$$

¹⁷⁰ IATA ADRM 10th Edition

Where Cf equals:

Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)	
For MQT	CF
3, and less	1.22
4	1.22
5	1.15
10	1.06
15	1.01
20	1.00
25	1.00
30	1.00

Table 29: Correction Factor (Cf) for Demand Variability (when less than 30-minute peak)¹⁷¹

Step 5. Calculate the maximum number of passengers in the queue.

$$Q_{MAX} = 0.495 * \text{Peak 30-min (corresponding to a 30-minute MQT)}$$

Step 6: Calculate the area required for the X-ray process using the following equation.

$$AXR = (XR * XRd * XRw) + Q_{MAX} * SP + (XR * XRw * 2 * W)$$

The corridor width will vary with the importance of passenger flows. Port Authority minimum standard width is 20 feet for all circulation corridors.

- ii. Secondary Screening (Public Health, Agriculture, Fish & Wildlife, etc.)

It is recommended to follow CBP regulatory requirements in Airport Technical Design Standards. These documents 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.

This office is usually located near secondary baggage inspection and may range in size from 200 to 900 square feet depending on the number of officers assigned and whether the USFWS requires examination and storage areas separate from the CBP¹⁷².

- iii. CBP support areas

The CBP guidelines require certain back-of-house areas for agent locker rooms, work-out areas, equipment storage, records-keeping, and other purposes. Designers shall follow the current CBP guidelines in force at the time.

¹⁷¹ IATA ADRM 10th Edition

¹⁷² ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.7, 2010

iv. FIS Exit Control

It is recommended to follow CBP regulatory requirements in Airport Technical Design Standards. These documents 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.

On the US non-secure side of the FIS exit, provide railings, low walls, and signage to prevent back-flow into the CBP inspection areas. Provide architectural barriers so that it is not possible for meeters / greeters, or other members of the public, to see into the CBP inspection areas. One-way flow may be controlled by staff, or automated exit lanes similar to exiting from secure side to non-secure side of the terminal.

7. International Recheck (Passenger and Baggage)

This process is similar to an originating passenger and can be sized in a manner similar to a kiosk bag drop because the bags should be tagged to their final destination. Some staffed counters should also be provided to accommodate flight re-bookings or to issue new bag tags if the original tags are damaged. Queues for transfer passengers are typically shorter than queues for originating passengers due to relatively short processing times¹⁷³.

Refer to Part 2, Section 5, Traditional Check-in Counters.

8. Meeter / Greeter Area

The number of meeters/greeters will depend not only on local passenger characteristics but also on how long prior to scheduled arrival times the meeters/greeters enter the terminal. This information should be determined by survey¹⁷⁴.

i. Space Calculation

P	=	Persons Present in Arrivals Hall
PHP	=	Terminating Peak Hour Passengers
T _(P/V)	=	Dwell Time for Passengers/Visitors (in minutes)
VR	=	Ratio of Visitors per Passenger
A	=	Area of the Arrival Hall
SR	=	Seat Ratio
SP _(S/ST)	=	Space per Seated/Standing Person

Table 30: Meeter/greeter area calculation inputs¹⁷⁵

Step 1: Calculate the number of person present in the arrivals hall using the following equation:

$$P = (PHP * T_p) / 60 + (PHP * VR * T_v) / 60$$

¹⁷³ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.5, 2010

¹⁷⁴ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.8.6, 2010

¹⁷⁵ IATA ADRM 10th Edition

Step 2: Calculate the area to provide in the arrivals hall using the following equation:

$$A = (P * SR * SP_s) + (P * (1 - SR) * SP_{st})$$

Source: IATA ADRM 10th Edition, Section 3.4.13.5, 2017

9. Concessions

Refer to Part 2, Section i, Concessions (Post-Security Area / Concourse)

10. Restrooms

Refer to Public Terminal Restrooms Appendix for the *PANYNJ Airport Planning Standards Guidelines for Public Terminal Restrooms*.

11. General Visitor Information

The area required is relatively small, but location, typically on the arrivals pathway for passengers or in the baggage claim area, and visibility are crucial to the effectiveness of the service¹⁷⁶.

12. Domestic Arrivals

i. Backflow Prevention / Exit Lanes

Backflow prevention corridors should be sized to meet the peak demand, which is usually a surge of passengers from several simultaneous arriving flights. However, the width must be of a manageable size (not too wide) and the corridor of sufficient length for the officer's view range and to properly channel arriving passengers such that persons attempting illegal back-flow into the secure area can be detected and stopped.

It is expected that queuing for the automated exit lanes will be infrequent or negligible, unless an alarm occurs. Automated exit lanes will have a certain throughput of passengers per hour (in the order of about one passenger per two seconds or about 1,500-2,000 passengers per hour), and so the minimum number that must be provided is dictated by the peak arrival demand, which is usually a surge of passengers from several simultaneous arriving flights.

ii. Domestic Arrivals / Baggage Claim Hall

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.

iii. Space Calculation

Sizing of the arrivals hall is calculated separately from concession areas. The size of the arrivals hall depends on the number of persons during the peak hour, the amount of time passengers and visitors spend in the public area, the space they require as well as the number of seats to be provided. It is assumed that passengers carry their baggage while moving in this area¹⁷⁷.

The total amount of this area is ultimately determined by the number of passengers expected to be near the claim unit and the desired LOS. This area includes the active claim depth along the unit (retrieval

¹⁷⁶ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.14.4, 2010

¹⁷⁷ IATA ADRM 10th Edition, Section 3.4.13.5.3, 2017

area), depth for others in the traveling party, plus a circulation zone to and away from the Terminal Building Facilities claim unit (peripheral area). It has been found, however, that 15 feet is typically the minimum recommended depth for the retrieval and adjacent peripheral areas at all airports¹⁷⁸.

This depth results in a minimum separation of 30 feet between adjacent claim units or the “arms” of a flat plate claim. Columns, bag cart racks, and other structures should not be within the retrieval area. Objects located within the peripheral area usually will require additional separation. A minimum separation between the active claim area and walls or baggage cart racks is recommended to be 25 feet for both domestic and international claim units.

Additional area, outside of the peripheral claim area, needs to be provided for access to the claim area, circulation to ground transportation counters (rental cars, public transportation, commercial vans, etc.), seating for meeters/greeters and passengers waiting for transportation pick-up, etc. The dimensions of this circulation zone is 20 feet minimum, with additional width required dependent on projected passenger volumes and functions adjacent to the claim units, such as rental car counters.

P	=	Persons Present in Arrivals Hall
PHP	=	Terminating Peak Hour Passengers
T _(P/V)	=	Dwell Time for Passengers/Visitors (in minutes)
VR	=	Ratio of Visitors per Passenger
A	=	Area of the Arrival Hall
SR	=	Seat Ratio
SP _(S/ST)	=	Space per Seated/Standing Person

Table 31: Baggage claim area calculation inputs¹⁷⁹

Step 1: Calculate the number of person present in the arrivals hall using the following equation:

$$P = (PHP * T_p) / 60 + (PHP * VR * T_v) / 60$$

Step 2: Calculate the area to provide in the arrivals hall using the following equation:

$$A = (P * SR * SP_s) + (P * (1 - SR) * SP_{st})$$

Source: IATA ADRM 10th Edition, Section 3.4.13.5.4, 2017

When calculating the overall arrival hall size, concession space within the arrival hall shall be calculated separately from the total arrival size of the arrival hall. Refer to Section i Concessions (Post-Security Area / Concourse)

iv. Domestic Baggage Claim System

Refer to Part 2, Section p, International Baggage Claim System

¹⁷⁸ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.7.5, 2010

¹⁷⁹ IATA ADRM 10th Edition

v. Airline Baggage Service Office

Refer to Part 2, Section p, Airline Baggage Service Office (International Arrivals)

vi. Baggage Carts

Refer to Part 2, Section p, Baggage Carts (International Arrivals)

vii. Meeter/Greeter Area

In the case of a meeter/greeter lobby, seating may account for a smaller portion of the area with greeter standees and passenger circulation through the space making up the bulk of the area. The number of meeters/greeters depends not only on local passenger characteristics, but also on how long prior to scheduled arrival times the meeters/greeters enter the terminal¹⁸⁰.

Refer to Part 2, Section p, Meeter / Greeter Area (International Arrivals)

viii. Concessions

Refer to Part 2, Section i, Concessions (Post-Security Area / Concourse)

ix. Restrooms

Refer to Public Terminal Restrooms Appendix for the PANYNJ Airport Planning Standards Guidelines for Public Terminal Restrooms.

x. General Visitor Information

Refer to Part 2, Section 16, General Visitor Information (International Arrivals)

q. General Public Areas

1. Methodology

i. Circulation

Refer to Part 2, Section i (Circulation Section in Post-Security Area / Concourse.)

The program area is usually based on a percentage of the other public areas of the terminal and typically ranges from 15% to 30% of these areas. The percentage is a first approximation and will also vary with the terminal configuration and gross size of the terminal. The split between secure and non-secure (public) circulation is also a function of the terminal concept.¹⁸¹

ii. Vertical Circulation

Escalators

The majority of passengers will use escalators (up to 90%) as compared to stairs or elevators. Escalators should be sized to handle peak surge loads (5-minute periods) without excessive queuing.¹⁸² Escalators should be located such that if queues do develop, they will not interfere with other functions. More

¹⁸⁰ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.9.2, 2010

¹⁸¹ ACRP Report 25, Vol 1, Airport Passenger Terminal Planning and Design, Chapter VI, Section 3.10.41, 2010

¹⁸² ACRP Report 25, VI.3.10.6

important, there must be adequate space at the exit from escalators (or moving walks) so that passengers do not “back-up” on an escalator, which is a safety hazard. Where successive escalators are encountered, there should be a 40 foot gap between the respective escalator landings.

Elevators

The size and number of elevators at a given location will depend on the expected use. They can either be pushed (hydraulic) or pulled (traction), and each use depends on the number of floors being served. Because most passengers will use escalators, waiting time and speed are often not as important as providing a minimum size for wheelchairs and attendants.¹⁸³

2. Restrooms

Information used to develop restroom requirements include:

- Demand basis
 - Identification of governing building and plumbing codes
 - Type of Construction identification
 - Determining demand by location (concourse, public areas, etc.)
- Level of service criteria
 - Fixtures per male/female ratio
- Dimensional criteria (space template)

ACRP Report 130, *Guidebook for Airport Terminal Restroom Planning and Design*, provides more detailed explanations and best practices for planning and designing terminal bathrooms.

Above and beyond code requirements, airport restrooms should be designed with more space than restrooms in typical commercial or public buildings due to airport passengers often having carry-on baggage and other possessions.

See Public Terminal Restrooms Appendix for the *PANYNJ Airport Planning Standards Guidelines for Public Terminal Restrooms*

3. Concessions

Refer to Part 2, Section i, Concessions (Post-Security Area / Concourse)

4. Facilities for Passengers with Disabilities

As with any public accommodation, airport designers are responsible for complying with local codes and the Americans with Disabilities Act (ADA). IATA ADRM 10th Ed., 3.4.15., discusses design considerations when planning for facilities to accommodate passengers with disabilities.

i. Processing Facilities

Processing facilities should be designed to be accessible to passengers in wheelchairs as well as ambulant passengers with reduced mobility. Some service desks/counters should be designed with a lower height to allow those in wheelchairs to speak to service associates at an “eye-to-eye” level.

¹⁸³ ACRP Report 25, VI.3.10.6

ii. Self-Service Equipment

A number of the self-service processing facilities should be adapted for use by people with disabilities. The height of some self-service units should be reduced to enable access at wheelchair height. In addition, a clear and easily locatable designated point should be provided for those who may have trouble with the self-service equipment. Similarly, automatic ticket machines should be adapted for access from wheelchair height

iii. Reserved Seating Areas

Seating areas reserved for persons with disabilities should incorporate signage to discourage others from using them. These areas should be close to a staffed desk or designated point, and be reasonably close to essential facilities, such as toilets and refreshments. Seating areas for people with disabilities should be discreet and consideration given to special privacy requirements.

iv. Public Facilities

All areas and services in the terminal building that are open to the public should be accessible to people with disabilities. The airport/airline provides escorts and wheelchairs to passengers transferring between flights if they request wheelchair assistance. Wheelchair storage should also be located to minimize the average amount of time needed to reach any gate in a single concourse.

Toilet facilities for passengers needing assistance should be provided throughout the terminal, sized to allow for full access by people with disabilities and a second person for assistance. Specially designed facilities that address the special needs of those who are unable to stand or walk should be located at sufficient intervals. Embossed tactile markings should be used where appropriate, such as on the wall adjacent to door handles at accessible toilets. Refer to Public Terminal Restrooms Appendix for the *PANYNJ Airport Planning Standards Guidelines For Public Terminal Restrooms*.

v. Security

Security checks can be a source of concern for people with disabilities because of issues such as sensitivity around physical searches or handling of specialized mobility or medical equipment. Aisle widths and passenger screening equipment should permit the passage of passengers using wheelchairs.

With a view that, as far as practicable, people with disabilities should be self-sufficient, those designing screening points should consider the height of preparation and reclaim tables as well as the accessibility of trays. Automated roller beds and tray return systems avoid passengers having to push/pull multiple trays. This helps all passengers, but aids people with disabilities.

If no lanes dedicated to people with disabilities are used, consideration as to how an individual with a disability will reclaim baggage/trays after screening (without impacting the passenger flow) should also be a priority.

vi. Gate Facilities

Priority seating should be installed at the gate. Seating should be provided for at least one caregiver who may be traveling with an individual with a disability. Priority boarding should also be provided to allow special needs passengers additional time to board the aircraft prior to other groups. Where aircraft are

on remote stands, the transport links to and from these stands should be accessible to an individual with a disability.

vii. Baggage Retrieval, Immigration and Customs

Baggage claim, immigration and customs areas should allow for the passage of wheelchair users and passengers being transported in airport buggies.

5. First Aid / Emergency

The scale of facilities and their purpose should determine the location, which, however, should be chosen whenever possible within walking distance of the passenger area(s). Facilities should be strategically located for easy accessibility in case of an aircraft accident and be capable of expansion to serve on short notice as an enlarged aircraft accident first-aid receiving station.¹⁸⁴

6. HVAC

Building mechanical systems (HVAC) space ranges from 12 to 15 percent of the gross total space approximated for all other terminal functions. A value of 10 to 12 percent is used in relation to the connector element space. This allowance does not cover separate facilities for primary source heating and refrigeration (H&R plants).¹⁸⁵

It may be appropriate to consider HVAC system backup. Most terminals are fed from a central electrical plant, either remotely or on site. Although electrical HVAC equipment may be powered by an emergency generator, the chilled water system may not, which negates the effectiveness of the electrical components in the cooling system. Sensitive electronic equipment in a non-air-conditioned room may become damaged or will shut down in a short time due to overheating.¹⁸⁶

7. Lighting

Maximize the use of daylighting to decrease the amount of artificial lighting, as well as minimize the amount of heating and cooling of the area. Automatic daylight dimming controls for the lighting can greatly reduce energy costs, but consideration of glare control is also important to ensure occupant comfort.

Reduce the light power density for the project by selecting efficient fixtures and ballasts and by increasing the surface reflectivity of walls, floors, and ceilings. Lighting controls can also have an effect. Consider occupancy sensors when appropriate and employ automatic daylight dimming controls.¹⁸⁷

8. Public Address / Visual Paging System

Public address (PA) systems should provide a range of services including local and area-wide paging and public notification. Audio speakers should be placed and audio output should be dynamically adapted to ambient noise levels so that announcements can be clearly heard throughout the local areas even at

¹⁸⁴ ICAO Doc 9184 12.3

¹⁸⁵ FAA AC 150-5360-13, 78

¹⁸⁶ ACRP Report 25, VI.4.2.11

¹⁸⁷ ACRP Report 25, III.8.2 and III.8.3.3

peak traffic levels. Performance specifications should be based on acoustic testing or, where this is not possible, on acoustic modeling of the local environment. The PA system should enable individual zones to be paged by a PC-based administration interface that provides controls for audio inputs, outputs, and control signals.

When used for emergency notification, PA systems should provide supplemental reach to overhead paging, parking, inter-building, and even individual area notification including compliance with Federal Emergency Decision and Notification Protocol and other inter-agency requirements.¹⁸⁸

9. Wayfinding & Signage

The following are factors to consider when developing a signage and wayfinding program:

- Graphic standards – a uniform visual theme that complies with industry, international standards and local code is important and should be consistent in appearance, concept, and location; carefully considering font type, font size, character spacing, and signage illumination for a wide range of users. Note that it is good practice for temporary and tenant branded signage to be consistent with airport graphic standards.
- Terminology – consistent and easy to understand wording is important.
- Spacing – a consistent frequency of signage and placement is a value, considering building design and passenger flows.
- Maintenance and fabrication – materials and site locations should optimize signage maintenance.
- Code compliance – program should accommodate all special requirements, such as ADA Standards for Accessible design and local building codes.¹⁸⁹

ACRP Report 52, *Wayfinding and Signage Guidelines for Airport Terminals and Landside*, provides more detailed explanations and best practices for developing signage and wayfinding programs.

10. Advertising

A well-developed advertising program will ensure that all sites and media are fully integrated with the terminal architecture and environment, all sites are located for maximum effectiveness and sales, advertising does not conflict with wayfinding and other commercial signage, and the latest sign/telecommunications technologies are incorporated where appropriate.

An in-terminal advertising program should include the following elements:

- Identification of the optimum media range for the terminal and the markets specifically served by the airport
- Identification of the best locations for each type and size of advertising media
- Identification of the optimal number of advertising units for the terminal, by type
- Sites and networks to promote airport retail and other services to passengers

¹⁸⁸ ACRP Report 25, VI.4.6

¹⁸⁹ FAA 150/5360-13A, 6.4.12

- Identification of the rules that the advertising provider(s) will need to follow in operating the advertising business at the airport
- Design guidelines for the key advertising units, including sizes and parameters to be respected by the designers.

In-terminal advertising includes static displays such as dioramas, baggage claim device wraps, baggage cart advertising, banners, wall wraps, product displays, concession advertising, digital screens, nontraditional advertising, sponsorships, and other creative advertising locations.¹⁹⁰

r. Design Criteria

1. Circulation

Refer to Part 2, Section i (Circulation Section in Post-Security Area / Concourse.)

2. Vertical Circulation

Refer to ACRP Report 25, VI.3.10.6 for layouts and dimensions for escalators and elevators.

In front of elevator doors, and at the end of escalators, provide 8 – 10 feet of clear space for waiting and/or changing directions, before any cross circulation, walls, objects, etc.

3. Restrooms

The PANYNJ has reviewed the ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design; Port Authority Pedestrian Signing and Wayfinding Airport Standards Manual; Americans with Disabilities Act (ADA) Standards for Accessible Design; among other relevant documents. APD has established recommendations based upon the reviewed documents including but not limited to:

- Restroom Requirements and Planning Considerations for Restroom Location
- Fixture Needed Calculation – Methodology Guidelines
- Design Considerations for Spatial Relationships
- Accessibility Considerations
- Design Preferences
- Artistic Feature Requirements

Refer to Public Terminal Restrooms Appendix for the *PANYNJ Airport Planning Standards Guidelines for Public Terminal Restrooms*.

4. Concessions

Refer to Part 2, Section i, Concessions (Post-Security Area / Concourse).

5. Wayfinding & Signage

ACRP Report 52, Wayfinding and Signage Guidelines for Airport Terminals and Landside, provides more detailed explanations and best practices for developing signage and wayfinding programs.

¹⁹⁰ ACRP Report 54, 6.10

6. Advertising

The following table from ACRP Report 54, 6.10, is an example for the design considerations for advertising sizes and locations from an advertising master plan done for another airport.

Type of Advertising Unit	Size	Recommended Locations in Terminal	Specific Location in Sample Terminal	Total number of units (advertising faces)
Backlit column format (single or double sided)	55" x 37"	In locations where people are on the move and not stationary	Double-sided, in the circulation areas of the plaza between the octagons and in the bus stations	34 (68)
Backlit horizontal (single or double sided)	40" x 50"	In locations where people are on the move and not stationary	Double-sided, in the circulation areas of the plaza, facing the restaurant areas	18 (36)
Indoors spectacular backlit	8' x 10'	In locations where people are on the move and not stationary	On the washroom walls, facing the main bus parking	35
Wall wraps	Various sizes (very adaptable)	Inside circulation corridors; around building columns; on jet bridges	Proposed to identify the sponsored zones. To be used around each main terminal column in the specific sponsored zone, which are contiguous to the circulation corridors with octagons, and the circulation corridor where the main food and concession area is located	42
Exhibition areas	Various areas for various products with sales personnel	In wide circulation areas where people have time to browse	In the large area between the main plaza food and concession area and the central check-in area	1

Table 32: Sample advertising criteria

s. Back-of-House Areas

1. Methodology

i. Employee screening

If employee screening is combined with KCM screening, refer to Section 8.

ii. Airline Spaces

The ATO is usually located immediately behind, or in proximity to, the check-in counter to provide support functions for the airline staff handling check-in and ticketing. Typically, these offices are 25 to 30 feet deep along the length of the counter.

At non-hubbing airports, other offices are typically provided for the equivalent of 10 to 25 square feet/linear foot of ATO counter, but requirements can vary greatly.¹⁹¹

The demand for operations areas is a function of the size and types of aircraft being operated and individual airline operating policies. A planning-level program area for operations can be based on the number of gates (as expressed in EQA) and airlines at an airport.

Operations areas may range from less than 1,000 square feet/EQA, to well over 2,000 square feet/EQA at hub locations.¹⁹²

iii. Concessions Spaces

ACRP Report 54, 11.3 provides percentages regarding the storage areas for concessions:

Category	Storage (percent of leasable concession space)
Duty free	30%
Food and beverage	15%
Convenience retail	20%
Specialty retail	15%
Services	10%

Table 33: Storage space requirements by concession category¹⁹³

For additional information, refer to Part 1, Section 4.

iv. Port Authority Spaces

There is no rule of thumb for sizing airport offices because each airport has different staffing requirements and management structures. Planning for these facilities should be considered early in the programming process with input from the airport operator.

Some airports prefer to locate management offices within the terminal while others prefer a location in a separate building. Such location decisions depend on the size of the airport staff, availability of space in the terminal, and the cost/benefit of in-terminal vs. remote locations for a given airport management's operating philosophy.¹⁹⁴

¹⁹¹ ACRP Report 25, VI.3.11.1

¹⁹² ACRP Report 25, VI.3.11.3

¹⁹³ Source: ACRP Report 54

¹⁹⁴ ACRP Report 25, VI.3.14.4

v. Other Agencies' Offices and Support Spaces

Airport Police/Security Office space needs vary according to based staff and nature of arrangements with local community law enforcement agencies.¹⁹⁵

vi. Other Tenants' Offices and Support Spaces

A percentage of the functional areas (1% to 2%) is generally used in the absence of specific airport requirements for maintenance, janitorial and storage areas.¹⁹⁶

vii. Ramp Control

If a ramp control tower or room is to be provided, the designer should consult directly with the operator for requirements. The control room size will generally be dependent on the number of staff operation positions (usually 3-6), and equipment. It is preferable, but not mandatory, to have direct visual access to the area under control. Areas not visible can be covered with cameras. In addition to the control room, support spaces including coffee station, meeting / training room, storage, IT room, and staff lockers may be provided.

In the near future, ramp control towers may migrate to a "remote tower" model with staff in a ground-level room viewing high-resolution monitors, with visual access provided exclusively via a high-quality camera array mounted on a tall pole or antenna structure. Such remote towers have been implemented at a few locations in Europe and Australia, and are in the test pilot stage in the US at the time of this writing.

viii. Vehicle Screening

Screening should occur at a location far enough from the terminal or other sensitive area to ensure that a dangerous vehicle is interdicted well before it is able to cause damage to any intended target. The screening location must include a barrier to prevent further intrusion, adequate room for security workers to perform the inspection, space to store any specialized equipment, shelter for workers and/or working animals, and a method for a rejected vehicle to turn and leave the screening area.

The capacity of the screening location should be determined based on the number of vehicles in the peak hour, available manpower, available space to perform simultaneous inspections, and available parking positions at the terminal.

ix. Loading Docks

Estimating the number and size of loading docks involves many factors: the location (landside or airside); the relative size of the terminal; whether concessions have a central receiving area separate from the terminal; the number of individual concessions that may get separate deliveries; the average size of delivery trucks (vans, larger straight trucks, or semi-trailers); and airport policies with regard to operating hours.¹⁹⁷

¹⁹⁵ FAA AC 150-5360-13, 78

¹⁹⁶ ACRP Report 25, VI.3.14.2

¹⁹⁷ ACRP Report 25, VI.3.14.3

x. Incoming Goods Screening

Screening should occur at a location far enough from the terminal or other sensitive area to ensure that a dangerous vehicle is interdicted well before it is able to cause damage to any intended target. The screening location must include a barrier to prevent further intrusion, adequate room for security workers to perform the inspection, space to store any specialized equipment, shelter for workers and/or working animals, and a method for a rejected vehicle to turn and leave the screening area.

The capacity of the screening location should be determined based on the number of vehicles in the peak hour, available manpower, available space to perform simultaneous inspections, and available parking positions at the terminal.

xi. Trash and Recycling

Trash rooms should be large enough to accommodate the trash handling equipment required and to provide storage for packaged trash generated during a 3-day period. Space should be provided for sorting paper, glass, and metals for recycling. Airports that have trash containers that are picked up by vendors should have at least one loading bay for the trash container.¹⁹⁸

xii. Building Services (MEP)

At the planning and programming stage, utilities areas are typically estimated as a percentage of the enclosed functional areas of a terminal. This percentage will vary with the geographic location of the terminal, the provision of central plant functions either within the terminal or remotely and, in some cases, architectural design considerations that may limit the use of roof-top equipment.

Most newer terminals allocate space to utilities in the range of 10% to 12% of functional areas if the terminal has its own heating/cooling plant, but many terminals are outside of this range. The existing percentage should be calculated and adjusted for expansions based on the adequacy of existing facilities.¹⁹⁹

Recent trends in computer systems, telecommunications, and other building systems have increased the demand for utility space in many terminals. Some of this increased demand may be accommodated in the airline operations areas, whereas common-use systems need to be accommodated in airport-controlled areas.

xiii. IT/Communication Rooms and Facilities

Due to the distance limitations of copper Ethernet cabling, telecommunications rooms should be distributed throughout the terminal to provide adequate capacity coverage and reach for both planned and future applications. Working space around equipment racks for maintenance personnel should be provided, and there should be enough room to accommodate reasonably foreseeable future expansion requirements. Telecommunications room design should address panel space for cable terminations, switches and relays, remote field panels, remote diagnostic and management computer stations, and power service with redundancy and/or emergency backup capability, as appropriate. Special

¹⁹⁸ ACRP Report 54, 11.6.7

¹⁹⁹ ACRP Report 25, VI.3.14.1

consideration should be given to providing adequate physical clearance to access the equipment including HVAC service based on thermal analyses of installed equipment and local UPS to power equipment in the event of a power failure.²⁰⁰

2. Design Criteria

i. Employee Screening

[Under development]

ii. Airline Spaces

FAA AC 150-5360-13, 70 provides different layouts and dimensions for ATO/support space. Tenant airlines should be consulted to assess their floor area requirement, as the requirements vary considerably by airline.

iii. Vehicle Screening

Final denial barrier placement is based on the activation time for weapon delivery methods and the response time needed for a given scenario. For example, to stop a high-performance vehicle that accelerates from a stop at the ID check, given an 8-second response time, an active barrier should be placed approximately 330 feet from the access control point so that it can close before the vehicle reaches it.²⁰¹

iv. Loading Docks

ACRP Report 54, 11.1.2, provides a useful table regarding the sizes of the loading dock areas:

Size of Terminal Concession Area	Required Loading Bays
Up to 50,000 square feet of gross floor area	1 per 25,000 square feet or fraction thereof of gross retail floor area
Between 50,000 square feet and 100,000 square feet of gross retail floor area	1 per 20,000 square feet or fraction thereof of gross retail floor area
Over 100,000 square feet of gross retail floor area	5 plus 1 per 50,000 square feet or fraction thereof of gross retail floor area over 100,000 square feet

Table 34: Loading dock requirements as a function of concession floor area ²⁰²

t. Landside Automated People Mover (AirTrain)

The Port Authority airports have developed or are developing Automated People Mover (APM) systems to transport passengers between terminals or between terminals and other landside activity centers, such as parking and rental car facilities, ground transport centers, and local transit stations at or near the airport. The Port Authority has branded their APMs under the name “AirTrain,” and each of the AirTrains that exist or are under consideration operate on the non-secure side, or landside, of the

²⁰⁰ ACRP Report 25, VI.4.2.11

²⁰¹ Site and Urban Design for Security, Guidance Against Potential Terrorist Attacks, FEMA 430, 5.5.2, December 2007

²⁰² Source: ACRP Report 54, 11.1.2

airport, meaning that the passengers who ride these systems have not cleared security prior to boarding the trains.

The main purposes of landside APMs are to reduce airport roadway congestion and relieve roadway capacity shortfalls by enabling large-scale airline hubbing operations (connecting separate landside terminals) and convenient connections to landside facilities and regional transit that otherwise may only be provided by roadways.

Even though the development of the AirTrain's primary infrastructure would generally be the responsibility of the Port Authority, developers must know how large each station, platform, and other supporting facilities must be within their terminal development area to handle peak hour passenger demand. Therefore, developers are required to coordinate with the Port Authority to review existing and future AirTrain plans and incorporate system requirements into their station design.

1. References

- ACRP Report 37: *Guidebook for Planning and Implementing Automated People Mover Systems at Airports*
- ACRP Report 37A: *Guidebook for Measuring Performance of Automated People Mover Systems at Airports*
- ACRP Report 118: *Integrating Aviation and Passenger Rail Planning*
- IATA ADRM, 10th Edition
- National Fire Protection Association (NFPA) 130: *Standard for Fixed Guideway Transit and Passenger Rail Systems*

2. Planning and Design

Landside APM systems are usually designed to accommodate passengers with large checked baggage or even baggage carts. Therefore, the same APM vehicle may have a different effective capacity if it is being used in an airside post-security location as opposed to a landside pre-security location. Trip times on these systems may be long to reach remote parking lots, rental car sites, or off-airport intermodal facilities. The general functions of landside APM systems are described below.

Landside Circulation — APM systems enable the movement of passengers between airport activity centers such as terminals, parking lots, and rental car centers. These APM systems reduce the number of buses operating on the airport roadway, thereby lessening roadway congestion and auto emissions on airport property.

Sufficient integration of a landside APM system into the terminal complex will allow terminals to expand their physical size and passenger throughput while still meeting level-of-service thresholds for connect time and walk distance.

Transit Connections — APM systems also serve to connect an airport terminal with an urban or regional transit system. Passengers can connect to transit systems such as city buses or regional rail systems through intermodal centers. These APM systems also help to reduce roadway congestion and auto emissions.

When an APM connects a terminal to a regional rail station, passengers arriving from that rail service will impact the function and operating patterns of the in-terminal station. Passenger arrival patterns at the station via the regional rail service depend on that service's train frequency and capacity. Typically,

long trains arrive periodically and discharge a large group of passengers in a very short time. Such surged demand must be accommodated by the high capacity provided by high frequency APM service.

Major international airports have a wide variety of land uses on their premises. With airport growth, the expansion of terminals and roadways often forces other facilities such as rental car centers and parking structures to relocate to more remote locations. Landside APMs have been used to facilitate and serve such relocations at many airports.

It is recognized that with the expansion of PANYNJ's airports to accommodate growing passenger demand, it is critical that terminals improve and increase landside APM access to and from the facilities.

Goals:

- Promote transit modal access to the airport by providing a nearly seamless connection to airport facilities from regional transit.
- Reduce regional auto congestion and emissions by reducing/eliminating airport bus traffic and thus allowing an airport to increase its origination / destination capacity for a given roadway system.
- Integrate AirTrain stations with terminal planning to provide passengers with more convenient connections that facilitate seamless passenger flows to the terminal, a critical factor in providing a high-quality passenger experience.
- Provide direct, convenient connections to the road and AirTrain landside surface access that are within short walking distances. IATA standards suggest a walking distance of less than 1,000 feet between conveyance systems.
- Provide multiple passenger processing facilities that are connected via AirTrain, shuttle buses and walking routes to provide frequent and quick connections, operationally connecting the processing facilities and importantly ensuring convenient land and airside passenger flows.
- Better connect separate processing terminals to allow hubbing operations between facilities.
- Provide a multifunction landside APM that serves more groups within the airport organization and passengers such as car rental, passenger and/or employee parking, and regional rail.

3. APM Car Occupancy Demand

Consideration should be given to the effect of high peak flows on multi-station APMs that can lead to trains filling to capacity at early stops, leaving passengers unable to board the train further down the line. This condition can lead to increased Minimum Connecting Times (MCTs) and a poor perception of the level of service. Careful airline allocation, both during planning and operations, can help to minimize this problem but not necessarily eliminate it. Passenger flow peaking profiles are a vitally important design input.

4. APM Station Design Requirements

i. Pedestrian/Passenger Circulation Requirements

- Pedestrian flows shall be safe, direct, and convenient.
- Passengers with reduced mobility shall have appropriate access to and egress from the AirTrain station, as well as an ease of movement within the AirTrain station. ADA guidelines shall be strictly adhered to.
- Passengers shall be provided with appropriate directional guidance to ticketing, information, station exits, and any other appropriate destination.

- Bi-directional passenger flow must be provided between the passenger queuing areas and the platform area.
- There shall not be obstructions (e.g. columns, queue areas, signage etc.) in the primary pedestrian paths of travel.
- A sufficient number of doors shall be provided at each entrance, exit, and any other doorway to accommodate the projected pedestrian traffic flow.
- Adequate queuing and run-off space shall be provided for all public stairs and escalators. The required queuing and run-off areas for vertical circulation elements shall not overlap unless otherwise noted herein.

ii. Passenger Circulation Design Criteria

The general process for sizing transit facilities to handle passenger capacity begins with three steps:

- Identify the unit capacity for each circulation element and establish acceptable LOS for passenger circulation.
- Quantify the inbound passenger flow and capacity requirements of the passenger circulation elements restricting exiting from the facility.
- Quantify the outbound passenger flow and capacity requirements of the passenger circulation elements restricting access from the entrance to the platform and train.

Because entering passengers are assumed to arrive steadily throughout the course of the peak hour, there is a constant flow of passengers towards from the entry to the platform. That escalator's capacity is thus sized by dividing the forecast hourly entering volume by the hourly capacity of a single vertical circulation element (stair or escalator). The forecast hourly volumes are multiplied by a surge factor of 1.3 since surging is anticipated in the peak hour. The 1.3 surge factor is the typical industry standard surge factor used for designing transit facilities.

The capacity of these circulation elements is determined considering:

- The maximum throughput established for each passenger circulation element.
- The emergency egress requirements as determined by the National Fire Protection Association (NFPA) 130: Standard for Fixed Guideway Transit and Passenger Rail Systems.
- Minimum level of service (LOS) conditions governing interpersonal spacing and throughputs of passenger circulation elements under normal operating conditions.
- Any service standards (e.g., a requirement to clear the platform of arriving passengers within a given length of time after the trains arrives) established for performance.
- The waiting/queuing conditions at the platform level (in terms of passenger LOS and maximum time spent in or length of queue).

NFPA 130 egress requirements determine if the vertical circulation design meets the minimum passenger circulation design and performance standards for emergency evacuation. One of the primary provisions specified by the code is that there shall be sufficient exit capacity to evacuate station occupants (including those on trains) from platforms in 4 minutes or less and to a point of safety in 6 minutes or less.

Quality LOS design requirements are an industry design standard and different from NFPA 130 emergency egress requirements. NFPA 130 requirements only satisfy conditions during emergency evacuations while LOS requirements determine the operational performance standards required for

daily operations and functionality of the transit facility. LOS is covered in more detail in the following section.

5. Passenger Level-of-Service Criteria

Level of Service (LOS) pedestrian performance standards, established in *Pedestrian Planning and Design* (Fruin, 1971), provide a method for evaluating pedestrian circulation conditions and sizing elements. Unlike fire/life safety codes that may consider crush loads in emergency egress conditions, pedestrian LOS standards consider “normal” operating conditions, considering passenger comfort and convenience.

LOS performance standards establish a basis of design that considers human movement under various crowding conditions as well as the physical dimensions of the human body in determining the practical capacity of passageways, stairs, escalators, elevators, and other circulation elements. The normal psychological preference of avoiding contact with other passengers is also a determinant of inter-person spacing in queues and other crowded situations. It should be noted that this psychological envelope or personal space is often influenced by cultural and environmental factors.

The available space for passengers within AirTrain station platforms is impacted by the presence of baggage and other devices such as baggage carts, wheelchairs, and strollers which take up space. The amount of space occupied by international travelers is often the highest among all airport users since they carry the most baggage (typically two or more bags) and have a higher likelihood of using a baggage cart. Domestic travelers typically carry less baggage than international travelers (one or two bags) and are less likely to use a baggage cart. Flight crews carry slightly less baggage than domestic travelers (typically one bag), and airport employees typically do not carry baggage. The mix of AirTrain passengers and the space they occupy can therefore affect the capacity of the system.

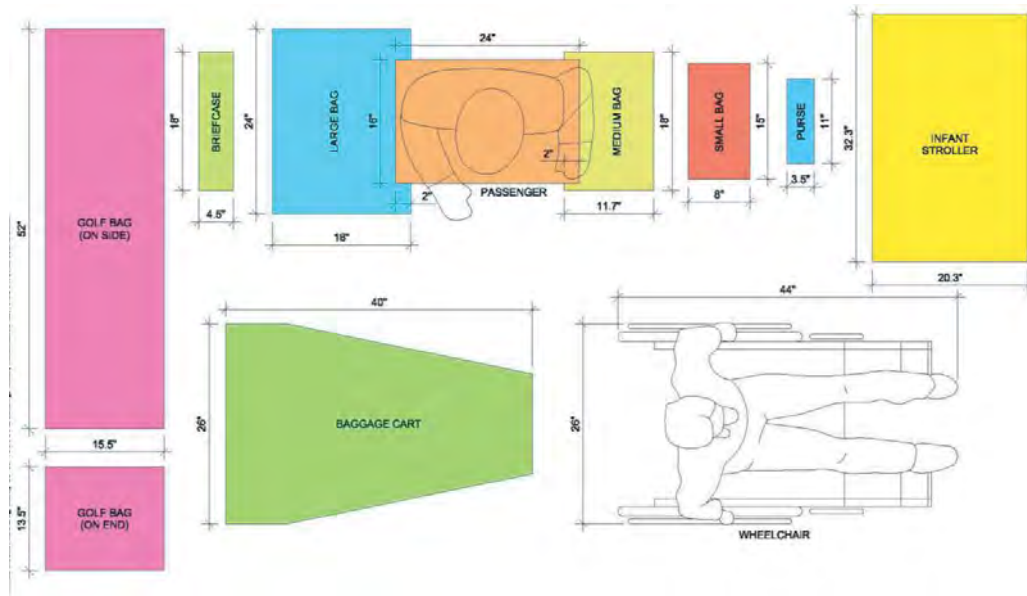


Figure 68: Typical Passenger Space Allocations²⁰³

²⁰³ ACRP Report 37: Guidebook for Planning and Implementing Automated People Mover Systems at Airports

The minimum capacity of the facility’s passenger circulation system is determined by the most stringent of these factors as applied to each element of the system. The key elements of the regular passenger circulation system (excluding emergency egress) are:

- Platforms
- Vertical Circulation Elements (elevators, escalators, and stairs)
- Passageways/Concourses
- Entrances/Exits
- Fare Gates and Turnstiles
- Ticket Vending Machines

All pedestrian circulation elements shall be appropriately sized to handle the projected passenger/pedestrian demand. These elements shall be designed to an acceptable passenger LOS C/D threshold (not to maximum capacity) utilizing the following LOS C/D parameters and consistent with the design guidelines as provided in this section:

Traffic Flow Element	Evaluation Criteria (without baggage)	Evaluation Criteria (with baggage)	Level of Service
Platforms	7 Square feet per person	14 Square feet per person	C/D
Queue Areas	7 Square feet per person	14 Square feet per person	C/D

Table 35: Platform and Queue Areas²⁰⁴

6. Platform Design

The platform area is where customers access trains. The platform area must facilitate multiple customer circulation functions: circulation along the platform, boarding and alighting trains, queuing at the platform edge while waiting for a train, queuing at vertical circulation elements, run-off at vertical circulation elements, and waiting at benches or rest areas. Because of these complex—and often conflicting—circulation characteristics, overcrowding on the platform may create uncomfortable, or dangerous situations where customers are crowded near the platform edge. Therefore, sizing platforms is critical and designers should err on the side of safety when determining the size of the platforms.

The following principles should be applied to the design of platforms:

- All elements of the platform area must support safe customer circulation and access to the trains.
- The design of the platform must minimize the need for circulating customers to make decisions that may cause unnecessary hesitation. Because platforms are typically crowded and subject to customer surges and cross flows, pausing customers can cause circulation problems for all patrons. The design of the platform shall meet NFPA 130 criteria and AirTrain criteria for clearance.
- Platform access points and vertical circulation elements should be situated to encourage balanced vehicle loading and unloading. Customers tend to board vehicles near the points where vertical circulation elements intersect the platform.

²⁰⁴ PANYNJ PATH Harrison Station Planning Standards

- Visual obstructions should be minimized and alcoves or other hidden areas on the platform avoided for orientation, safety, and security reasons.
- The platform areas should not contain any support or nontransit functions (e.g., vending or concessions) that may obstruct, inhibit, or impede customer circulation.
- The path of emergency egress along the platform must be clearly delineated by signage and lead as directly as possible to an area of safety.

i. Platform Clearance Requirements

The platform shall be designed to clear the platform of passengers in required platform clearance time or less by providing the number of vertical circulation units required for optimum vertical circulation operations of LOS C/D, during peak train demand load conditions during one peak hour. The LOS C/D design criteria to meet the platform clearance requirements:

- Required platform clearance time shall equal 80% of service headway. Design will be based on the AirTrain service line operating at three-minute headway during peak periods. Thus, for any AirTrain station, the required platform clearance time is 144 seconds.
- 70 passengers per minute for the average escalator capacity and 10 passengers per minute per foot were assigned to calculate platform clearance requirements.
- There will be 10 cars per train.
- Uniform passenger distribution clearance time is calculated by dividing the total train alighting volume by the total vertical circulation element exit capacity.

ii. Platform Length

Platform length is typically determined by the length of the longest train anticipated plus whatever additional length is required for operational considerations. In this case, the platform length will accommodate a 10-car AirTrain train.

iii. Platform Width

Platform width is typically determined by several factors:

- The width of any vertical circulation elements located within the length of the platform.
- A preferred minimum clear distance to any obstruction such as a vertical circulation element from the platform edge. This distance includes the 2'-0" wide platform safety edge, a clear passage for customers circulating along the platform length, and a 1'-0" buffer zone along the length of the obstruction. The edge of the platform shall be measured from the inside edge of the rubbing strip. The rubbing strip shall not be included in the width of the platform safety edge. The precise dimension is to be determined by passenger flow analysis and code.
- Patronage and emergency exiting requirements.
- Space requirements as determined by Level of Service requirements.

The total width of the platform is equal to the sum of these factors. In no case, should the width of the platform be less than the minimum standards established herein or by the PANYNJ.

In addition to vertical circulation elements, circulation space, safety edges, and buffer areas, platforms must provide room for the following program requirements, many of which may contribute to the width of the platform:

- PANYNJ facility phones (e.g. General, Pay and Passenger Assistance)
- AirTrain vision monitors
- Benches
- Passenger information displays/variable messaging system
- Platform end gates
- Fire department facilities (e.g., standpipes, hose cabinets, and extinguisher cabinets)
- Underplatform access, such as manholes
- Support areas (service and support spaces)
- Emergency egress (e.g. stairs, vestibules, corridors as required)

u. Information Services

Airports continually strive to improve customer service to meet the growing levels of sophistication and service demanded by today's passengers. Customer satisfaction is influenced by the presence and degree of various stressors along the journey, with the onus on the airport and airlines to reduce or eliminate as many of these friction points as possible. Airports and airlines are making improved customer service a priority through providing passengers accurate, timely, and actionable information – collectively known as “information services”, reducing the uncertainty inherent in various parts of the airport experience.

1. References

- ACRP Report 13 - Integrating Airport Information Systems
- ACRP Report 25 - Airport Passenger Terminal Planning and Design
- ACRP Report 157 – Improving the Airport Customer Experience

2. Flight Information and Passenger Information

Flight information is the most fundamental category of information for passengers. The standard approach is to use monitors or screens showing departing flight destination cities, flight numbers, times, gate numbers, and status. The screens and the IT system that supports them are known as Flight Information Display System or FIDS. With mobile technology, other options for receiving flight information are supplementing FIDS. These include²⁰⁵:

- Text messages or emails from the airline notifying the passenger of departure time, gate number, and any flight status changes.
- Flight status on airline apps, usually through push notifications.

²⁰⁵ ACRP 157 Improving the Airport Customer Experience, Section 8.16

- Flight status available through third-party apps, airport apps, or mobile websites. These approaches usually require the passenger to seek the information.

It is likely that the use of mobile devices to receive flight status information will continue to grow, however, FIDS must continue to be provided at key locations such as the ticketing hall and immediately after security checkpoints, and other zones where passengers must make wayfinding decisions. In addition, the use of visual paging can help minimize the acoustic clutter in busy terminals, whereby video screens show messages for passengers as an alternative to voice announcements²⁰⁶.

3. Passenger Tracking and Queue Management

Customer perceptions of wait time are influenced by the quality of the information they have available about the expected wait time. People are subject to less stress when they have an accurate estimate of the amount of time they will spend waiting in a queue. Uncertainty over the time required to reach the departure gate is a major source of stress at the airport²⁰⁷.

Technology for measuring, managing, and predicting waiting times is available in new queue management systems now being used at several US, European and Asian airports. These systems use predictive software in conjunction with camera-based, Bluetooth or other technologies measuring of passenger flows to predict processing times and passenger movements in terminals.

i. Camera/Sensor-Based Systems

One kind of new technology for managing queues is about developing software and hardware that analyzes groups of people and how they are moving, how they are distributed, the time they are spending in a given place, and how many individuals are in a given area; then predicts movements and flows. This type of technology uses overhead cameras or sensor and software to monitor persons without the use of facial recognition systems. The predictive software can monitor the status of queues at airline check-in counters or security checkpoints, and then provide counts, densities, travel times, and predictions based on movements. In addition, a mobile app can inform airline and airport managers of current conditions and issue alerts that allow them to make decisions about staffing and opening new counters or checkpoint lanes, and can inform other decisions.

ii. Bluetooth-Based Systems

Bluetooth-based systems use the unique Media Access Control (MAC) address of phones and mobile tablets when Bluetooth is enabled to monitor the time it takes passengers to go through the checkpoints using sensors on predetermined paths. This technology can also be useful for monitoring and managing wait times at check-in, in taxi queues, at retail concessions, in baggage claim, and in immigration and customs queues, and can provide an overall picture of how terminal facilities are operating on any given day.

²⁰⁶ ACRP 157 Improving the Airport Customer Experience, Section 8.16.1

²⁰⁷ ACRP 157 Improving the Airport Customer Experience, Section 8.4

iii. Facial Recognition Systems

Facial recognition software applications for airports use overhead cameras throughout the airport to measure and monitor the number of persons in queues, times their processing to identify current or predicted bottlenecks, and provides guidance on real-time staffing to manage current and projected queue lengths.

Unlike a Bluetooth-based system, which relies on passengers having their smart phones' Bluetooth function switched on, this type of system uses facial recognition to identify individual passengers, and time their movements through the system. The system does not personally identify individuals, but it does track an individual anonymously throughout the airport. The system creates a biometric, numerically coded identifier for the passenger upon the passenger entering the terminal. At each waypoint, the customer's face is matched to existing identifiers.

The cumulative data of many passengers is used to develop average, minimum, and maximum wait times, which are communicated to airport staff at a desktop computer showing the dashboard, which includes current and predictive reporting, or through a mobile app. Airport staff can respond by opening additional lanes, adding staff, or diverting passengers to another queuing area. The airports are also able to use the software to analyze concession usage.

iv. Beacons

The recent popularity of beacon technology at airports has fostered new opportunities in terminal design, and their use goes beyond identifying locations. With an add-on sensor, beacons can enhance certain features within the terminal by monitoring temperature ranges and lighting levels and then sending signals back to the heating and ventilation system to self-adjust throughout the day. This not only reduces the airport's energy consumption but also enhances the overall passenger experience.

Because of the technology's capability to deliver hyper-contextual content to the passenger, beacons can serve as a wayfinding tool for passengers to navigate around the terminal independently, get up-to-date airline boarding information or changes, and receive targeted concessions coupons as passengers pass through certain points within the terminal. Keeping the passengers informed can allow for less trafficked spaces to still be visible to the passenger and navigate to.

In addition, beacons can track passenger patterns through Bluetooth technology. Data collected can be used to inform airports of bottleneck/congestion points and customers' spending habits so that airports can more effectively position retail and hospitality offerings to customers and provide personalized services. I-Beacon technology is illustrated in Figure 69²⁰⁸.

Terminal developers should discuss options for passenger tracking and queue management technologies with the constituent airlines, terminal managers, and other stakeholders to determine the optimal system or systems to deploy. Providing these systems can help terminal managers improve customer service and perceptions in the most efficient way, and can serve as a measuring tool for facility and staff performance.

²⁰⁸ ACRP Report 157 Improving the Airport Customer Experience, Section 7.3.1



Courtesy of SITA.

Figure 69: I-Beacon Technology ²⁰⁹

4. Digital Signage & Wayfinding

Airport operators, airlines, and passengers are rapidly adopting a wide range of digital technologies to smooth many facets of the air travel experience. Digital displays are an ideal fit for airports because their bright, dynamic images grab and hold attention, even in settings with abundant ambient light. They can be configured into many shapes and sizes, and be deployed both inside and outside air terminals.

i. Digital Signage

Digital signage offers many advantages over traditional static signs. They allow content to rotate, make updating content easy, and provide interactivity with touch-enabled screens.

Advances in light-emitting diode (LED) technology is creating opportunities to create large-scale high-definition (HD) displays of unlimited size, similar to the HD replay screens used in major sports stadiums. Large-format LEDs offer an affordable means of display for advertising, sponsorship information, local tourism promotions, public art, and other messaging. The most extensive and elaborate use of this technology in the United States is in the expanded Tom Bradley International Terminal (TBIT) at Los Angeles International Airport, where the installation serves as the public art component of the terminal project. Video art was chosen because the moving image is the medium for which Los Angeles is best known around the world. Two views of the Great Hall in the departures area are shown in Figure 70.

²⁰⁹ ACRP Report 157 Improving the Airport Customer Experience, Section 7.3.1



Figure 70: LAX Bradley International Terminal video art displays ²¹⁰

Besides substantial entertainment value, the video walls also give passengers another reason to stay in the terminal’s Great Hall, which also features an extensive array of shops and boutiques and a variety of dining options. Other airports are embracing this new technology for revenue-producing purposes.

ii. Digital Information Kiosk

Touch-enabled wayfinding kiosks can help passengers navigate the airport by providing detailed maps and a wealth of useful guidance showing passengers how to get to where they want to go. Boston Logan airport has invested in infobars (Figure 71), which are kiosks with interactive touch-screen devices that provide information to passengers, including automated maps showing how the customer can reach a desired location; concession information; and information on airline, concessions, and other services.



Figure 71: Infobar interactive kiosks at Boston Logan ²¹¹

iii. Walking Distance

Walking distances are a customer service issue when the length of the walking distance is an inconvenience for the passenger or a challenge for a person with reduced mobility. Eliminating or reducing the negative effects of long walking distances on the customer experience may require long-term fixes and significant capital investment. Therefore, it may require waiting until there is a major

²¹⁰ ACRP Report 157 Improving the Airport Customer Experience, Section 10.3

²¹¹ ACRP Report 157 Improving the Airport Customer Experience, Section 10.4.1

terminal refurbishment project in order to bring the costs and operational impacts to manageable levels²¹².

Some airports are indicating walking distance or time-to-walk estimates on airport flight information displays or terminal map displays in order to allow customers to plan their movements and manage their time effectively while the airport is able to manage expectations. An example of a directory with walk times at London Gatwick airport is shown in Figure 72. This is a simple and effective way to convey fundamental information to passengers, and is recommended for any terminal building with walking times greater than 15 minutes from security checkpoint to gate.



Figure 72: London Gatwick Airport directory with walking times to gates

iv. Restrooms

Survey research on customer satisfaction has established a direct link between the quality and cleanliness of restrooms and the overall customer experience.

Customer feedback on how well restrooms are meeting their needs can be obtained through a variety of means including touch-screen ratings. Many airports including Port Authority facilities have installed devices where passengers can rate the restroom using a five-point scale (shown in Figure 73). Some airports also allow touch-enabled displays that allow passengers to alert janitorial staff that a restroom needs cleaning or paper goods resupplied.

Customer feedback screens are recommended for all airports restrooms, because they improve passengers' perceptions of the airport caring about customer service, and provide real-time actionable information to airport staff responsible for restroom maintenance.



Figure 73: Restroom touchscreen feedback system ²¹³

²¹² ACRP Report 157 Improving the Airport Customer Experience, Section 8.5

²¹³ Singapore Airport

5. Virtual Assistants and Robot Ambassadors

In addition to the customer service staff at information booths, many airports also provide roving ambassadors or customer service representatives who move about the terminal or rail platforms during the airport's peak travel times. New types of roving ambassadors, such as roving customer service robots, have been introduced at a several airports.

Indianapolis International Airport (IND) was the first U.S. airport to debut a roving robot. It uses a standard iPad running FaceTime mounted on a stick figure wearing an IND polo shirt. IND staff remotely operate the robot and can be seen by and interact with the customer directly. The robot, which resembles a smaller version of the Segway transporter, is controlled via Wi-Fi connection, with the iPad showing a live video image of the operator, also carried by Wi-Fi, who can maneuver the robot and conduct conversations with passengers. The robot, as shown in Figure 74, is called a "personal airport consultant" and is popular with airport users and creates a human connection with passengers.

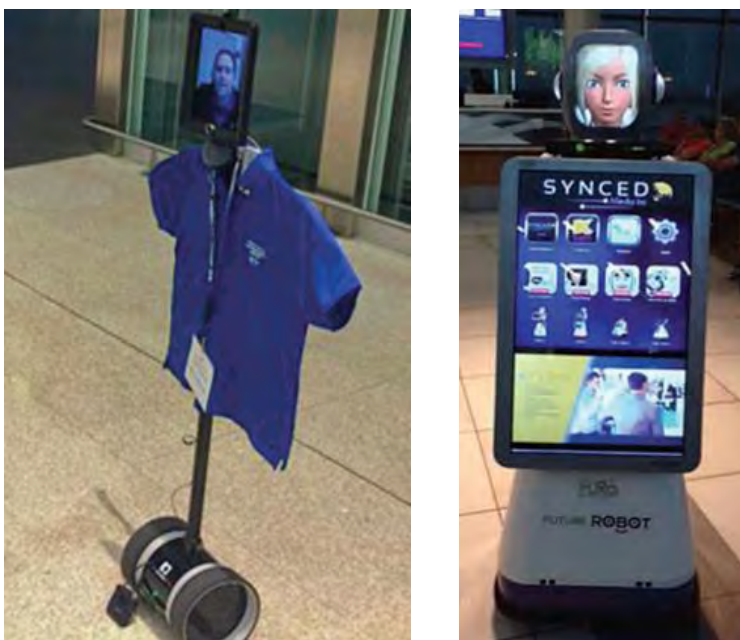


Figure 74: Indianapolis and Edmonton International Airports Airport Robots ²¹⁴

Edmonton International Airport (EIA) has also been testing a robot that is fully automated and has a touch screen with icons indicating how the robot can assist passengers, including leading passengers to their chosen destination. They have the potential to communicate in 30 different languages.

Similar virtual assistants are in use at Manchester, London Luton, and Birmingham airports in the UK, as well as some Port Authority terminals including JFK T5. The virtual assistants use holographic imaging technology and make the standard information announcements on prohibited items and inspection procedures to passengers entering the security checkpoint. The virtual assistants are attention grabbers and are less expensive than staff. The Manchester airport virtual assistant is shown in Figure 75.

²¹⁴ ACRP Report 157 Improving the Airport Customer Experience, Section 10.4.1



Figure 75: Holographic virtual assistant at Manchester Airport ²¹⁵

6. Automated Food Ordering Systems

Concession and holdroom integration is a growing trend to optimize passenger exposure to revenue-generating opportunities while providing a more pleasant experience for the passenger waiting to board²¹⁶. OTG Management, a food and beverage concessionaire, has installed thousands of tablets in its food and beverage locations at Newark-Liberty, LaGuardia, Kennedy, Minneapolis–St. Paul, and Toronto Pearson airports²¹⁷. The tablets allow for online ordering of food using a visual menu, which also makes recommendations. The tablets are loaded with games, news, and entertainment apps, a flight tracker app, Google maps, and other features to inform and entertain the customer before and after the meal. The visual menu is available in multiple languages, making it useful in international terminals.

At a few airports, online ordering is provided via airport or third-party apps and mobile websites, offering flexibility for online ordering for pickup or delivery at the gate without the attendant cost of installing touch-screen tablets.



Figure 76: Automated food ordering, Toronto Pearson International Airport ²¹⁸

²¹⁵ ACRP Report 157 Improving the Airport Customer Experience, Section 10.4.1

²¹⁶ ACRP Report 157 Improving the Airport Customer Experience, Section 7.3.3

²¹⁷ ACRP Report 157 Improving the Airport Customer Experience, Section 8.12.2

²¹⁸ ACRP Report 157 Improving the Airport Customer Experience, Section 7.3.3

Remote ordering is expected to grow as point-of-sale systems used by restaurant operators increasingly have the capability to support online ordering and payment. Touch-screen ordering is also expected to increase as an extension of point-of-sale systems at busy food and beverage concessions²¹⁹.

Terminal operators are encouraged to provide or enable online concessions ordering, as a time-saving customer service enhancement, and a way to promote retail concession sales, especially for concession outlets that are less visible or get less foot traffic due to their location.

²¹⁹ ACRP Report 157 Improving the Airport Customer Experience, Section 8.12.2

SECTION IV: LANDSIDE

Part 1 - Concept of Operation Parameters

1. Roadways

- a. Airport roadway should be designed to streamline traffic flows, enhance vehicular capacity, and improve overall access to, from, and between the terminals. Primary consideration should be given to the following design elements:
 1. Optimize free flowing traffic movements throughout the airport where possible;
 2. Eliminate or minimize signalized intersections using grade-separated structures;
 3. Maximize the length of merge and diverge points;
 4. Maximize the distance of weaving sections;
 5. Maximize the distance between motorist decision points; and
 6. Avoid multiple decision points in the same gore area.
- b. New landside facilities shall be designed to achieving a minimum Level of Service (LOS) threshold of C during the morning and evening peak periods. In addition, the designs shall meet the proposed future peak hour traffic demands based upon the design day flight schedule (DDFS) projections.
- c. The airport access roadway system shall provide airport access/egress, and circulation from/to:
 1. Main Access Highways; and, (Airport Specific)
 2. Local Street Network. (Airport Specific)
- d. The on-airport roadway system shall provide the following vehicular circulation and recirculation:
 1. Enter Direct to Terminal;
 2. Terminal to Exit;
 3. Enter Direct to Parking;
 4. Parking to Exit;
 5. Terminal to Parking;
 6. Parking to Terminal; and,
 7. Inter-terminal Connections.
- e. Direct ingress/egress shall be provided for delivery vehicles to/from the terminal loading docks.
 1. Terminal loading docks should be located so delivery vehicles are not required to pass through terminal frontage roadways to access the loading docks.
- f. All airport circulation and recirculation movements shall be provided on airport property.
- g. Roadway Elements
 1. Landside roadways should be designed taking into account coordination of existing conditions, critical design criteria, structural foundations, impacts to

both existing and proposed utilities and potential future transit systems, other elements include:

- Horizontal and Vertical Roadway Design;
- Roadway and Utility Phasing;
- On-grade and Elevated Pavement Design;
- Signage;
- Utility Routing;
- Storm Water Routing;
- Sanitary Sewer Routing; and,
- Pavement Removal.

h. Traffic volume assignments for each roadway link shall be developed as outlined in Part 2 of this section.

2. Terminal Frontage Curbside

Terminal frontages, carrying mostly air passenger traffic, are typically one-way roadways that operate in a counter-clockwise direction to enable passenger pick-up and drop-off by different modes of vehicles. Key factors in frontage roadway design include speed limit and other signage, pedestrian crossings (at-grade or grade-separated), adequate transition areas, sidewalk and curb widths, Americans with Disabilities Act (ADA) accessibility, and frontage curb capacity.

Based on various terminal configurations, clockwise operations may be desirable. Actual frontage length, lane requirements and operation parameters shall be developed based on the analyses outlined in Part 2 of this section.

Terminal frontage shall provide for the desirable Level of Service A curb space operation such that for a vehicle arriving at the terminal frontage, the probability of no space at the curb is less than or equal to 10 percent and the lane utilization factor is 0.9. This represents a “free-flow” frontage operation where there is little or no interference between vehicles or pedestrians.

Terminal frontages typically consist of four or five traffic lanes, usually with two lanes or one wide lane for passenger pick-up/drop-off, one lane for maneuvering, and one or two bypass lanes. Depending on the demand and terminal design a second independent high-occupancy-vehicle (HOV) arrivals and departure frontage or alternate pick-up/drop-off areas should be considered.

The frontage roadway layout should be organized to provide most efficient operations for travelers including provisions for curb front baggage check in and safe pedestrian crossings. ADA passenger loading and zones along the frontage should be identified and clearly marked.

Terminal frontages need to provide for the following ground transportation modes:

- Private Auto;
- Taxis;
- For-Hires – Black Cars, Private taxis, Uber, Lyft and other Transportation Network Companies (TNC);
- Public Transit/Coach Buses;
- Courtesy Vehicles – Hotels and Off-Airport Parking, etc.;

- On-Airport Buses/Vans – Airline Employees, etc.;
- Off-Airport Buses /Vans – Super Shuttles, Charter Buses, etc.;
- Delivery Vehicles - UPS, FedEx, Food Deliveries. etc.;
- Authorized Vehicles - Police, maintenance vehicles, Security vehicle, etc.; and,
- Other – Tow trucks, Contactor maintenance vehicles, etc.

Terminal frontages can be common shared frontage or individually segmented. At common curb frontages, the various vehicular modes share a common curb front making it unnecessary to separate traffic volumes by vehicle type. At an individually segmented curb front the different modes have their own processing area.

Arrivals curb frontages should be segmented to provide dedicated areas for the following:

- Taxis;
- Public Transit Buses;
- Courtesy Vehicles;
- On-Airport Buses; and,
- Off-Airport Buses.

Private auto, for-hires, TNC, delivery, authorized and other vehicles can utilize the common use section of the Arrivals frontage.

Independent High Occupancy Vehicle (HOV) frontages or alternate pickup/drop-off areas can be provided for the segmented functions of the Arrivals frontage, thereby freeing up common use curb frontage. HOV frontage can also be used to provide the departure's drop-off function for public transit buses, courtesy vehicles, on-airport and off-airport buses.

Departures frontages can be segmented or common use according to expected volumes and mode shares.

At-grade pedestrian crosswalks shall be signal controlled as a matter of safety. Crosswalks shall be conspicuously marked.

Pedestrian islands shall be provided with canopies for passenger comfort and protection from the weather.

3. Surface and Garage Parking

- a. All parking facilities shall comply with ADA and PA Sustainability guidelines.
 1. Minimize travel distances for recirculation to/from terminals and parking.
 2. Parking structures shall provide elevators for vertical circulation between levels.
 3. Grade separated terminal connectors shall be temperature controlled.
 4. Parking structures shall be provided with finishes to enhance views from the adjacent community.
 5. Functional Requirements
 - i. Short Term parking demand forecast for the airport shall be determined in accordance with the procedures outlined in Part 2 of this section.

- ii. The Long Term parking demand forecast for the airport shall be determined in accordance with the procedures outlined in Part 2 of this section.
 - iii. The parking demand forecast for an individual terminal shall be determined in accordance with the procedures outlined in Part 2 of this section.
 - iv. A service building to house revenue control system equipment, toll collector restroom, and other support space shall be provided at each exit plaza.
6. The parking facilities designs must comply with the Transportation Security Administration (TSA) 300-foot security standoff requirements for larger airports.

4. Taxi Hold Operations

- a. Prior to pick-up taxis must first go to a centralized taxi hold or staging area.
 - 1. Taxi pick-up will be at a dedicated area along the arrivals frontage, at the HOV frontage or at an alternate pick-up area.
 - 2. Prior to reaching the taxi dispatch location and fare pick-up zone, a taxi queue area in the vicinity of the arrivals level frontage must be provided.
 - 3. Taxi holds should be located to provide quick access for the taxis to reach the terminal taxi queue zone and the arrivals curbside, and can be located outside of the central terminal area (CTA).
 - 4. The terminal frontage sidewalk shall be designed to accommodate passenger queuing while waiting for a taxi.
 - 5. Taxi hold space, taxi queue area, curbside and frontage requirements shall be determined in accordance with the procedures outline in Part 2 of this section.
 - 6. Taxi drop-off typically occurs at the Departures frontage.
 - 7. After drop-off taxis may exit the airport or circulate to the central hold.
 - 8. Taxi hold areas require rest room facilities.

5. Transportation Network Companies (TNC) Operations

- a. Prior to pick-up TNC vehicles must first go to a centralized hold or staging area with geofence boundaries.
 - 1. TNC hold should be located to provide quick access for the drivers to reach the new terminal arrivals curbside and can be located outside of the central terminal area (CTA).
 - 2. TNC hold space requirements shall be determined in accordance with the procedures outline in Part 2 of this section.
 - 3. TNC drop-off typically occurs at the Departures frontage.
 - 4. After drop-off TNC vehicles may exit the airport or circulate to the central hold.
 - 5. TNC hold areas require restroom facilities.

6. Cell Phone Lots

- a. Cell phone lots should be located to provide quick access for drivers to reach the terminal arrivals frontage and can be located outside of the CTA. Motorists coming to the airport just

- to pick-up arriving passengers should first go to one of the nearby cell lots to wait. Once the arriving party reaches the terminal sidewalk with luggage in hand, he or she can then call the driver, and the waiting motorist can be curbside within minutes to quickly pick up the traveler and be on their way.
- b. Cell phone lots are needed because of airport security concerns. Cars are no longer allowed to linger outside terminals in loading zones, forcing motorists to circle the area again and again while waiting for arriving parties. This causes congestion with slow-moving traffic and encourages accidents.
 - c. Before cell phone lots, motorists would park along airport roadways waiting for calls from arriving passengers. Many received tickets, and the illegal practice made it difficult to police the airport and adjacent areas properly. Conversely, some motorists would use nearby hotel parking lots, gas stations, and mini-marts to wait for calls. As a result, cell phone parking lots have become a virtual necessity.
 - d. Designated cell phone lots make it easier for law enforcement to control and monitor areas surrounding airports. Moreover, airport traffic moves smoother, faster, and more efficiently, as people approaching the terminals already know where their party is waiting. Motorists are able to get in and out quickly and easily, whether dropping parties off or picking them up.
 - e. Motorists must stay in their cars while using the lots. Time limit (e.g., one hour) should be imposed to avoid using the cell phone lots as an alternative to parking. Cell phone lots should be provided with rest room facilities.
 - f. The cell phone lot(s) space requirements shall be determined in accordance with the procedures outlined in Part 2 of this section.

7. Bicycle Access

- a. Consider impacts of bicycle storage and supporting facilities, such as showers and locker rooms, that may influence the terminal program requirements for employees and passengers traveling with bicycles to the airport made possible by access on buses, shuttles, or an Airtrain System.
- b. Planners should refer to the PANYNJ Sustainable Infrastructure Guidelines: Appendix 03 and the PANYNJ Sustainable Building Guidelines for more information regarding the PANYNJ's sustainability rating program and integration with USGBC for bicycle installations.

8. Landside Utilities

- a. Existing utilities should be relocated outside the footprint of new structures.
- b. New utilities should be located outside the footprint of new structures.
- c. Utilities should be located such that they are accessible for maintenance/repairs.

Part 2 - Landside Traffic Analysis Methodology and Design

1. References

- Airport Cooperative Research Program (ARCP) Report 25, Volume 1: Airport Passenger Terminal Planning and Design.
- ACRP Report 40: Airport Curbside and Terminal Area Roadway Operations.
- 2010 Transportation Research Board Highway Capacity Manual (HCM).
- Most recent Airport Data Collection Report (if available).
- Existing and Future Design Day Flight Schedules (DDFS).
- Americans with Disabilities Act (ADA) Applicable Standards and Guidelines

2. Landside Traffic Analysis Methodology

The objective of the landside traffic analysis is to support the design team in identifying the optimal configuration for the airport landside facilities (roadways, terminal curbside, parking, taxi operation, etc.) in response to new airside and terminal design arrangements.

The evaluation process entails developing a traffic simulation model, such as VISSIM, which utilizes dynamic and static assignment methods to direct traffic to specific parking facilities and terminal frontages, analyzes curbside vehicle loading and unloading at terminal frontages, evaluates the landside roadway network and uses iterative dynamic assignment methods to direct traffic into and out of the airport via the least congested route.

The traffic volumes to be used in the analyses shall be developed from existing and future Design Day Flight Schedules (DDFS) and other parameters including, but not limited to, the air passenger cumulative distributions at curbside frontage arrival times, vehicle occupancy rates, and expected modal splits.

Figure 77 provides a flow chart that identifies the individual steps of this process which will be specified in greater detail below.

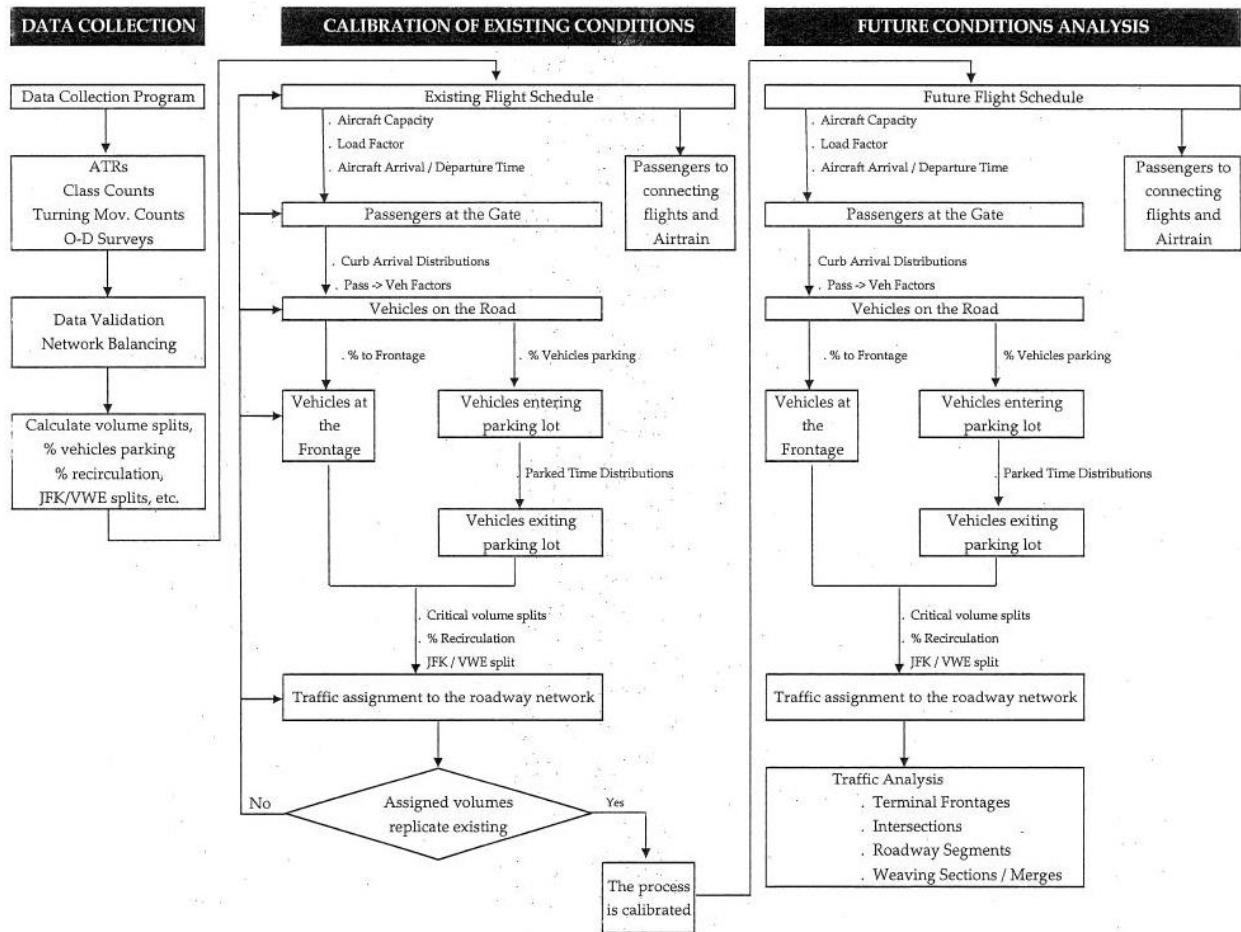


Figure 77: JFK Airport traffic analysis methodology

3. Landside Traffic Data Collection Program

a. Purpose

The purpose of the traffic data collection program is to obtain current information for the roadways within and leading into and out of the airport Central Terminal Area (CTA), as well as, the vehicle and pedestrian activity at the individual terminal curbside frontages. The data should include, but not limited to, traffic counts, vehicle classifications, curbside dwell times by vehicle mode, pedestrian counts, physical inventories of lane configurations, curbside space allocations, parking and taxi operations and travel time surveys. The information is necessary to calibrate the existing conditions traffic simulation model and to develop balanced traffic volume flow maps to reflect base year conditions. Presently, VISSIM is the preferred simulation modeling platform.

The data can be obtained using various equipment and methodologies, which include, but not limited to, automatic traffic recorders, video cameras, and field personal.

General observations should also be made to study the extent of double and triple parking, lane blockages, queue lengths and durations, and pedestrian-vehicle interactions. Several other sources of data should be explored including taxi pool dispatch data and vehicle entry-exit flows to parking facilities.

1. Month and Duration of the Data Collection

The data should be collected for a 7-day period during the month of August, typically the peak month for air passenger activity at the airport. During the duration of the study period, equipment and personnel must be monitored on a daily basis to ensure that data are accurately recorded for the correct time interval.

2. Data Collection Plan

Prior to implementing the data collection program, a thorough, well-thought-out data collection plan is required to ensure the success of the effort. All the logistics and details need to be fully developed because a problem with even one detail can cause a problem with the entire data collection program. It is also important to prepare for the unexpected, to the extent possible, and have a back-up plan, because most data collection efforts involve events out of one's control, such as traffic incidents, weather, and other unplanned incidents. The data collection plan must be submitted for approval prior to implementation of the program.

3. Automatic Traffic Recorders (ATR)

Automatic Traffic Recorders (ATR) should be installed on key roadway segments to measure continuous directional traffic in 15-minute intervals for the entire duration of the study period. Data from the ATRs represents the temporal distribution of vehicular volume throughout the day, as well as throughout the week. Traffic volumes should be recorded in 15-minute intervals and aggregated into hourly volume profiles by day.

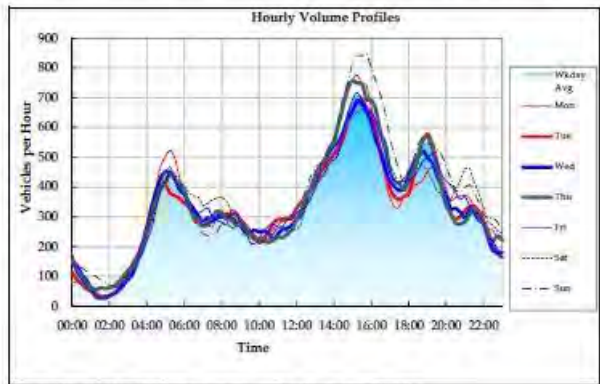
JFK International Airport 2015 CTA Data Collection Program
Automatic Traffic Recorder (ATR) Counts

ATR SUMMARY TABLE - VEHICLE COUNTS									
LOCATION No		7							
STREET NAME		Entrance Ramp to Terminal 8 from Van Wyck Expressway							
DESCRIPTION		ATR							
DATA TYPE		RAW VEHICLES							
Interval Beginning	15-Minute Volumes							Ave. of Tue, Wed, Volumes	
	8/23/2015	8/24/2015	8/25/2015	8/26/2015	8/27/2015	8/28/2015	8/29/2015	15-Minutes	Hourly
00:00	60	28	35	38	58	51	47	44	137
00:15	35	13	33	42	27	42	48	34	115
00:30	30	22	25	27	41	32	27	31	95
00:45	45	20	21	37	26	27	21	28	75
01:00	20	23	11	31	24	17	17	22	58
01:15	35	17	17	34	12	13	12	14	44
01:30	18	7	10	7	14	10	12	10	40
01:45	28	6	12	8	14	6	7	11	39
02:00	20	11	5	4	15	8	4	8	43
02:15	22	4	6	7	17	7	6	10	51
02:30	12	9	9	7	13	10	8	10	66
02:45	16	10	16	15	16	10	15	16	87
03:00	14	21	11	15	21	13	16	16	106
03:15	26	38	23	20	33	14	27	25	126
03:30	22	37	35	26	29	27	32	30	160
03:45	44	27	39	28	37	45	40	35	196
04:00	49	49	41	36	30	28	43	36	256
04:15	58	58	58	62	59	55	54	60	322
04:30	74	91	62	78	58	55	72	66	372
04:45	82	84	101	88	96	83	86	95	411
05:00	99	103	108	108	88	68	92	101	424
05:15	118	125	99	117	112	124	126	109	423
05:30	85	161	91	121	104	115	114	105	406
05:45	136	114	109	105	111	115	122	108	386
06:00	96	123	79	103	117	102	108	100	369
06:15	108	96	92	95	91	88	97	93	339
06:30	74	93	81	87	87	92	93	85	311
06:45	77	75	93	91	92	85	104	92	290
07:00	20	79	69	74	65	71	87	69	275
07:15	64	72	57	78	61	71	83	64	294
07:30	60	55	99	63	72	86	90	65	292
07:45	50	60	86	72	72	94	76	77	307
08:00	62	96	71	87	78	77	93	79	304
08:15	69	66	76	63	78	42	99	72	300
08:30	68	93	67	80	91	75	95	79	298
08:45	80	76	86	71	63	88	80	73	289
09:00	60	58	82	81	63	68	77	75	277
09:15	57	71	71	65	74	89	72	70	262
09:30	60	71	73	65	72	68	68	70	248
09:45	63	70	64	99	62	59	60	62	239
10:00	58	56	64	60	58	44	53	61	230
10:15	56	52	53	64	51	44	55	56	234
10:30	47	45	53	72	56	63	51	60	236
10:45	49	59	54	53	51	77	57	53	242
11:00	75	59	70	63	61	67	61	65	295
11:15	70	63	72	56	46	61	67	58	259
11:30	63	61	83	54	63	69	39	67	266
11:45	25	89	65	69	62	68	74	65	276
12:00	79	71	71	78	39	69	68	69	304
12:15	89	69	74	61	58	84	46	64	324
12:30	63	78	89	64	77	68	66	77	364
12:45	100	76	95	89	96	91	76	93	393
13:00	101	94	90	90	90	82	89	90	425
13:15	125	110	101	107	103	94	106	104	459
13:30	110	109	103	109	106	95	90	106	485
13:45	129	138	116	119	141	124	119	125	512
14:00	112	115	124	131	118	114	114	124	536
14:15	129	138	127	132	128	114	120	129	566
14:30	152	145	123	134	144	132	126	134	608
14:45	165	165	135	146	165	130	160	149	662
15:00	190	173	147	142	176	140	140	155	691
15:15	202	190	158	164	190	189	154	171	708
15:30	196	190	179	179	206	189	171	188	706
15:45	238	211	177	171	185	179	173	178	668

ATR SUMMARY TABLE - VEHICLE COUNTS									
LOCATION No		7							
STREET NAME		Entrance Ramp to Terminal 8 from Van Wyck Expressway							
DESCRIPTION		ATR							
DATA TYPE		RAW VEHICLES							
Interval Beginning	15-Minute Volumes							Ave. of Tue, Wed, Volumes	
	8/23/2015	8/24/2015	8/25/2015	8/26/2015	8/27/2015	8/28/2015	8/29/2015	15-Minutes	Hourly
16:00	207	185	169	177	169	160	152	172	651
16:15	201	159	120	151	186	165	169	169	597
16:30	204	186	140	154	154	167	146	149	535
16:45	188	134	165	136	183	162	131	161	489
17:00	161	120	108	112	133	127	126	118	423
17:15	154	93	90	120	110	111	126	107	399
17:30	144	71	99	92	118	110	103	103	386
17:45	100	82	96	96	95	98	115	96	386
18:00	105	85	83	93	94	103	96	90	413
18:15	96	99	80	107	105	103	100	97	458
18:30	109	105	110	103	97	119	119	103	503
18:45	156	92	105	139	122	102	116	122	544
19:00	131	106	140	130	136	111	134	135	549
19:15	147	106	153	129	145	127	116	142	519
19:30	135	119	157	123	153	147	103	144	466
19:45	134	121	128	117	136	112	104	127	404
20:00	125	120	109	113	95	125	99	106	354
20:15	137	97	95	86	89	105	83	89	316
20:30	114	94	78	89	81	102	88	83	301
20:45	95	82	71	83	77	87	75	77	297
21:00	81	83	66	70	68	112	109	68	300
21:15	98	106	79	86	54	81	123	73	321
21:30	108	96	85	77	76	78	114	79	325
21:45	113	84	90	64	85	96	115	80	301
22:00	89	75	79	95	93	83	107	89	279
22:15	71	71	82	76	72	58	75	77	236
22:30	72	70	65	53	49	71	79	56	203
22:45	76	60	60	51	61	65	69	57	197
23:00	74	59	42	44	34	39	58	47	189
23:15	74	64	36	39	56	42	66	44	
23:30	38	45	38	47	64	44	58	50	
23:45	43	54	48	51	48	36	64	49	
24 HR VOL	8,752	8,005	7,722	7,782	8,037	7,865	8,068	7,847	

AM Peak Hour							
HR BEG	05:00	05:15	05:30	05:45	06:00	06:15	06:30
HR VOL	448	523	407	451	444	436	470
P.H.F.	0.82	0.81	0.80	0.83	0.85	0.92	0.93

PM Peak Hour							
HR BEG	15:45	15:15	15:30	15:45	16:00	16:15	16:30
HR VOL	850	776	695	691	757	717	665
P.H.F.	0.89	0.92	0.97	0.97	0.92	0.95	0.94



*Note: Due to logistical reasons, Sunday volumes from 0:00 to 13:00 were obtained from Sunday, August 30, 2015. Volumes from 13:15 to 23:45 were obtained from Sunday, August 23, 2015.

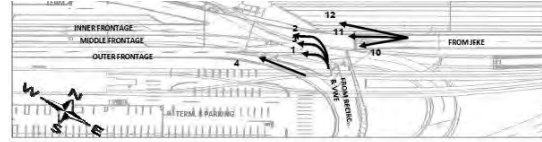
Figure 78: Sample format for ATR count

4. Turning Movement Counts (TMC)

Turning Movement Counts (TMC) video cameras should be installed at key intersections to record continuous traffic volumes by movement during the study period. Data collected from the TMCs show the distribution of vehicular and pedestrian movements at each intersection. The turning movement count volume data should be aggregated in 15-minute and hourly intervals for all vehicular and

pedestrian movements at each intersection and classified into three vehicle types: autos; trucks; and, buses. Data should be compiled from the video recordings for one weekday for the 6:00 AM to 10:00 AM peak and the 4:00 PM to 8:00 PM peak periods. The counts are to be performed for a typical weekday, free of major incidents. If the day the counts are conducted is deemed not to be a typical weekday, the counts shall be performed on an alternative weekday within the survey period.

TMC SUMMARY TABLE - VEHICLE COUNTS	
LOCATION No.	1
STREET NAME	Terminal 8 Arrivals Entrance
DESCRIPTION	TMC
DATA TYPE	Vehicles
DATE	Friday, August 28, 2015
TIME PERIOD	5:00 AM to 3:00 AM and 2:00 PM to 8:00 PM



Direction:	15-Minute Volumes												Approach Total (15-Min)			Intersection Volume						
	Northbound 1			Northbound 2			Westbound			Right - 12			NB 1	NB 2	WB	15-Min	Hourly					
	Left - 1	Thru - 2	Left - 3	Left - 4	Left - 10	Thru - 11	Right - 12															
Movement:	Auto	Bus	Truck	Auto	Bus	Truck	Auto	Bus	Truck	Auto	Bus	Truck	Auto	Bus	Truck							
Vehicle Type:	Auto	Bus	Truck	Auto	Bus	Truck	Auto	Bus	Truck	Auto	Bus	Truck	Auto	Bus	Truck							
AM	05:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	0	15	28	230	
	05:15	0	0	0	1	3	1	7	0	0	15	0	0	6	0	0	12	15	0	22	49	282
	05:30	1	0	0	0	1	4	10	0	1	17	0	0	6	0	0	17	17	0	34	68	324
	05:45	0	0	0	1	3	0	9	0	0	26	0	0	11	0	0	15	26	0	44	85	344
	06:00	0	0	0	1	2	1	14	1	0	24	0	0	8	0	0	19	24	0	37	80	363
	06:15	0	0	0	2	2	1	13	0	0	24	0	0	15	0	0	19	0	0	15	9	0
	06:30	0	0	0	1	2	0	14	0	0	19	0	0	12	1	0	24	2	0	17	19	0
	06:45	1	0	0	4	3	2	17	0	0	31	0	0	12	0	0	13	0	0	21	0	0
	07:00	3	0	0	2	2	1	17	0	0	23	0	0	6	0	0	11	1	0	22	1	0
	07:15	4	0	0	3	0	0	20	0	0	13	0	1	11	0	0	22	0	0	11	0	0
	07:30	2	0	0	2	3	0	27	0	0	33	0	0	6	0	0	23	1	1	38	2	2
	07:45	1	0	0	0	3	3	24	0	0	29	0	0	12	0	1	21	1	1	25	0	2
	08:00	2	0	0	0	2	1	17	0	0	27	0	0	8	0	0	16	0	0	15	2	2
	08:15	0	0	0	1	2	0	22	0	0	17	0	0	10	0	0	20	1	1	9	0	2
	08:30	0	0	0	2	1	1	19	0	0	16	0	0	12	0	0	8	0	0	14	1	3
	08:45	3	0	0	1	2	1	16	0	0	16	0	0	7	0	1	9	0	0	19	0	1
	14:00	2	0	0	2	0	0	21	0	0	20	0	0	12	0	0	22	0	1	26	2	0
	14:15	1	0	0	0	3	0	29	1	0	16	0	0	13	0	0	21	1	0	24	1	0
	14:30	0	0	0	2	2	1	13	0	0	30	0	0	12	0	0	22	0	0	29	2	1
	14:45	2	0	0	2	3	0	12	0	0	19	0	0	18	0	0	20	0	0	7	0	0
	15:00	2	0	0	2	2	0	22	0	0	34	0	0	16	0	0	12	0	0	1	2	0
	15:15	2	0	0	2	3	0	29	0	0	60	0	0	24	0	0	22	0	0	27	1	0
	15:30	2	0	0	2	0	0	45	0	0	37	0	0	14	0	0	12	0	0	18	1	0
	15:45	2	0	0	1	3	0	54	0	0	42	0	0	26	0	0	27	0	1	28	1	0
	16:00	1	0	0	3	3	0	41	0	0	29	0	0	25	0	0	28	0	0	33	1	0
	16:15	3	0	0	1	1	0	53	0	0	37	0	0	13	0	0	43	3	0	38	1	0
	16:30	2	0	0	0	2	0	53	1	0	26	0	0	14	0	0	42	0	0	49	2	0
	16:45	5	0	0	3	3	0	54	3	0	23	0	0	10	0	0	25	2	0	36	0	1
	17:00	1	0	0	1	2	0	30	0	0	21	0	0	17	0	0	36	1	1	48	1	2
	17:15	3	0	0	1	3	0	37	1	0	24	0	0	8	0	0	29	1	1	36	0	1
	17:30	4	0	0	2	2	0	28	2	0	22	0	0	11	0	0	29	0	1	20	1	1
	17:45	2	0	0	4	3	0	31	0	0	20	0	0	9	0	0	20	1	0	27	0	0
	18:00	3	0	0	1	1	0	20	1	0	21	0	0	12	0	0	23	1	0	27	2	0
	18:15	6	0	0	3	2	0	27	0	0	27	0	0	15	0	0	12	1	0	34	0	2
	18:30	3	0	0	3	1	0	20	0	0	29	0	0	12	0	0	17	0	0	17	1	0
	18:45	3	0	0	2	1	0	18	0	0	37	0	0	10	0	0	21	1	1	17	0	0
	19:00	1	0	0	1	2	0	27	0	0	38	0	0	13	0	0	25	0	0	11	0	2
	19:15	0	0	0	2	2	0	21	0	1	40	0	0	25	0	0	10	0	0	9	0	1
	19:30	4	0	0	1	1	0	49	0	0	62	0	0	22	0	0	24	1	1	27	0	2
	19:45	5	0	0	2	2	0	27	1	0	53	0	0	10	0	0	34	0	1	32	0	0
PM	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	15:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	15:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	16:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intersection Peak Hour Summary	Peak Hour	NB 1			NB 2			WB			WB											
AM	07:15	Description	L-1	T-2	L-3	L-4	T-5	R-6	L-7	T-8	R-9	L-10	T-11	R-12								
		Total Vol.	9	17	88	183	-	-	-	-	-	39	87	113								
		PHF	0.56	0.71	0.81	0.78	-	-	-	-	-	0.73	0.87	0.67								
		PP%	0%	88%	0%	1%	-	-	-	-	-	3%	8%	67%								
PM	15:45	Description	L-1	T-2	R-3	L-4	T-5	R-6	L-7	T-8	R-9	L-10	T-11	R-12								
		Total Vol.	8	16	202	134	-	-	-	-	-	78										

not to be a typical weekday, the counts shall be performed on an alternative weekday within the survey period.

The dwell time are to be measured from the beginning that a vehicle stopped at the frontage and ended when the vehicle began to leave its parked position at the frontage. The occupancy is to be measured as the number of passengers who alighted or boarded the vehicle. The counts are to be summarized by 15-minute and hourly intervals.

The video recording should also be used to identify the number of vehicles parked in the second and third frontages lanes, queue lengths, queue durations, and average vehicle delays both for through traffic and curbside pick-up and drop-off.

When compared to approach ramp ATR counts, the video recordings can be used to separate through and recirculation traffic from traffic destined to the frontage curbs.

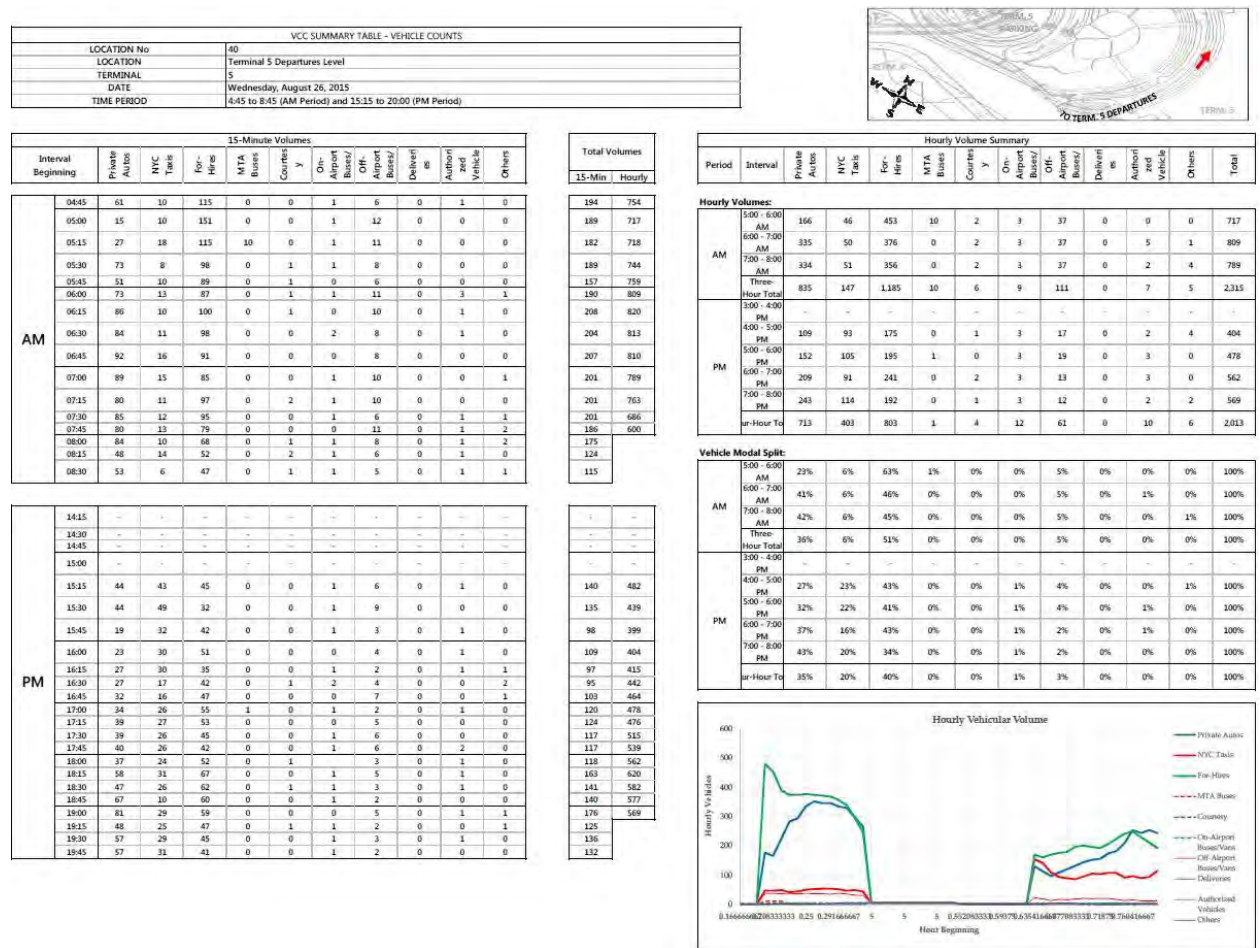


Figure 81: Sample format for frontage count

DOMESTIC TERMINAL - ANALYSIS VEHICLE DWELL TIMES AND OCCUPANCY RATES (Terminal 5)

Frontage	Vehicle Class	Dwell Time (sec)		Vehicle Occupancy Rate		Sample Size (No. of Vehicles)		% Breakdown by Vehicle Length Group				Equivalent Vehicle Length
		AM	PM	AM	PM	AM	PM	Cars	Vans (AM/PM)	Mini Buses (AM/PM)	Large Buses (AM/PM)	
Departing Flights	Private Autos	109	126	1.85	1.54	298	168	100%	-	-	-	25
	Taxis	78		1.51		67		100%	-	-	-	25
	For-Hire (Limo's, TNC, etc.)	92	110	1.87	1.66	163	136	100%	-	-	-	25
	Public Transit/Coach Buses	-	-	-	-	-	-	-	-	-	-	-
	Courtesy Vehicles[1]	59		4.20		5		-	40%	60%	-	35
	On-Airport Buses/Vans	252		5.75		4		-	-	75%	25%	38
	Off-Airport Buses/Vans	100		3.35		40		-	50%	45%	5%	38
Arriving Flights	Private Autos	122	99	1.72	1.87	95	105	100%	-	-	-	25
	Taxis	89	120	1.33	1.48	183	150	100%	-	-	-	25
	For-Hire (Limo's, TNC, etc.)	100		1.82		152		100%	-	-	-	25
	Public Transport Buses	-	-	-	-	-	-	-	-	-	-	-
	Courtesy Vehicles[1]	99		2.00		1		-	-	100%	-	35
	On-Airport Buses/Vans	217		1.50		2		-	100%	-	-	38
	Off-Airport Buses/Vans	229		2.68		19		-	69%	26%	5%	38

INTERNATIONAL TERMINAL - ANALYSIS VEHICLE DWELL TIMES AND OCCUPANCY RATES (Terminal 7)

Frontage	Vehicle Class	Dwell Time (sec)		Vehicle Occupancy Rate		Sample Size (No. of Vehicles)		% Breakdown by Vehicle Length Group				Equivalent Vehicle Length
		AM	PM	AM	PM	AM	PM	Cars	Vans (AM/PM)	Mini Buses (AM/PM)	Large Buses (AM/PM)	
Departing Flights	Private Autos	144		1.74		39		100%	-	-	-	25
	Taxis	97		1.59		269		100%	-	-	-	25
	For-Hire (Limo's, TNC, etc.)	134		1.38		53		100%	-	-	-	25
	Public Transit/Coach Buses	-	-	-	-	-	-	-	-	-	-	-
	Courtesy Vehicles	-	-	-	-	-	-	-	-	-	-	35
	On-Airport Buses/Vans	-	-	-	-	-	-	-	-	-	-	38
	Off-Airport Buses/Vans	297		3.31		26		-	77%	4%	19%	38
Arriving Flights	Private Autos	133		1.69		310		100%	-	-	-	25
	Taxis	94		1.39		104		100%	-	-	-	25
	For-Hire (Limo's, TNC, etc.)	94		1.45		269		100%	-	-	-	25
	Public Transit/Coach Buses	-	-	-	-	-	-	-	-	-	-	-
	Courtesy Vehicles	117		3.38		8		-	25%	75%	-	35
	On-Airport Buses/Vans	51		2.50		2		-	-	50%	50%	38
	Off-Airport Buses/Vans	101	129	3.03	4.23	38	57	-	58% / 63%	26% / 16%	16% / 21%	38

DOMESTIC/INTERNATIONAL TERMINAL - ANALYSIS VEHICLE DWELL TIMES AND OCCUPANCY RATES (Terminal 4)

Frontage	Vehicle Class	Dwell Time (sec)		Vehicle Occupancy Rate		Sample Size (No. of Vehicles)		% Breakdown by Vehicle Length Group				Equivalent Vehicle Length
		AM	PM	AM	PM	AM	PM	Cars	Vans (AM/PM)	Mini Buses (AM/PM)	Large Buses (AM/PM)	
Departing Flights	Private Autos	149	170	1.85	1.97	700	616	100%	-	-	-	25
	Taxis	89	108	1.48	1.75	160	239	100%	-	-	-	25
	For-Hire (Limo's, TNC, etc.)	100	109	1.69	1.95	499	622	100%	-	-	-	25
	Public Transit/Coach Buses	-	-	-	-	-	-	-	-	-	-	-
	Courtesy Vehicles	122		4.66		35		-	49%	51%	-	35
	Off-Airport	110	129	3.69	4.18	80	106	-	58%	34%	8%	38
	All Others	272		-		-		100%	-	-	-	38
Arriving Flights	Private Autos	158	171	1.77	2.02	232	273	100%	-	-	-	25
	NYC Taxis	106	101	1.59	1.89	359	377	100%	-	-	-	25
	For-Hire (Limo's, TNC, etc.)	164	149	1.63	2.01	193	289	100%	-	-	-	25
	Public Transit/Coach Buses	-	-	-	-	-	-	-	-	-	-	-
	Courtesy Vehicles[1]	116		2.67		3		-	100%	-	-	35
	Off-Airport[2]	455	331	3.56	3.72	32	46	-	64%	21%	15%	38
	All Others	197		-		-		100%	-	-	-	38

Figure 82: Sample format for dwell and occupancy count

Vehicle Class	Departures								Arrivals							
	AM Period (5 to 9 AM)				PM Period (3 to 7 PM)				AM Period (5 to 9 AM)				PM Period (3 to 7 PM)			
	4-Hour Volume	Vehicle Modal Split	Occ. Rate	Pax Modal Split	4-Hour Volume	Vehicle Modal Split	Occ. Rate	Pax Modal Split	4-Hour Volume	Vehicle Modal Split	Occ. Rate	Pax Modal Split	4-Hour Volume	Vehicle Modal Split	Occ. Rate	Pax Modal Split
Private Autos	1,523	54.5%	1.85	53.1%	1,357	42.6%	1.97	40.4%	824	43.2%	1.77	42.6%	1,328	46.6%	2.02	45.1%
Taxis	260	9.3%	1.48	7.3%	456	14.3%	1.75	12.0%	663	34.8%	1.59	30.8%	921	32.3%	1.89	29.2%
For-Hire (Limo's, TNC, etc.)	805	28.8%	1.69	25.7%	1,117	35.1%	1.95	32.8%	195	10.2%	1.63	9.3%	287	10.1%	2.01	9.7%
Public Transit/Coach Buses			1.8	4.2			1.9	4.2			2	4.5			2.1	5
Courtesy Vehicles[1]	46	1.6%	4.66	4.0%	22	0.7%	4.66	1.5%	18	0.9%	2.67	1.4%	2	0.1%	2.67	0.1%
On-Airport Buses/Vans									6	0.3%			4	0.1%		
Off-Airport Buses/Vans	142	5.1%	3.69	9.9%	211	6.6%	4.18	13.3%	153	8.0%	3.56	15.9%	255	8.9%	3.72	15.9%
Others	16	0.6%			20	0.6%			47	2.5%			55	1.9%		
Total	2,792	100%	1.90	100%	3,183	100%	2.08	100%	1,906	100%	1.80	100%	2,852	100%	2.09	100%

(A) Excludes recirculating vehicles and vehicles parking via the frontage road

Figure 83: Sample format for mode split calculation

7. Terminal to/from Parking Passenger Counts

Terminal to/from parking passenger count shall be conducted at each CTA parking facility to collect passenger volume between terminals and parking in both directions. These counts shall be conducted for one typical weekday at each terminal. The data collection shall cover a total of 15 hours on a weekday from 4:00 AM to 10:00 AM and from 1:00 PM to 10:00 PM. The counts are to be performed for a typical weekday, free of major incidents. If the day the counts are conducted is deemed not to be a typical weekday, the counts shall be performed on an alternative weekday within the survey period. The counts are to be summarized by 15-minute and hourly intervals.

8. Parking Data Collection

A parking study is required to evaluate the parking demand needs for the airport. Parking data containing the exact time that vehicles entered and exited the parking facilities shall be gathered and processed to illustrate the parking utilization throughout a typical day. Fifteen (15) minute entering and exiting volumes are to be obtained for each parking facility for a consecutive two-week period including the overall survey week. In addition, an on-site parking utilization survey should be conducted during the midday period on a typical weekday.

Traffic volumes entering and exiting on-airport parking lots are to be calculated for the 4:00 AM to 10:00 AM and 1:00 PM to 10:00 PM peak periods on a typical weekday (i.e., Tuesday - Thursday) using the 24-hour entry and exit transaction data provided by airport parking operator. The counts are to be summarized by 15-minute and hourly intervals. The counts are to be performed for a typical weekday, free of major incidents. If the day, the counts are conducted is deemed not to be a typical weekday, the counts shall be performed on an alternative weekday within the survey period.

To calculate the parking utilization for each parking facility, the entry and exit volumes are applied to the parking utilization numbers obtained from the on-site survey for the midday period. The daily turnover, or the amount of spaces made available for additional parking, should varies for each parking facility. These rates are calculated by dividing the daily exiting volumes by the capacity for each parking lot.

9. Cell Phone Lot and TNC Hold Area Counts

Vehicle entry and exit counts shall be conducted at each Cell Phone Lots and TNC Hold Areas. These counts shall be conducted for one typical weekday at each facility. The data collection shall cover a total of 15 hours on a weekday from 4:00 AM to 10:00 AM and from 1:00 PM to 10:00 PM. The counts are to be summarized by 15-minute and hourly intervals.

The information is necessary to support the design team in identifying cell phone lot and TNC hold sizing requirements. The information should identify the maximum accumulation of vehicles in the cell phone lots and TNC hold areas to determine sizing needs.

The counts are to be performed for a typical weekday, free of major incidents. If the day the counts are conducted is deemed not to be a typical weekday, the counts shall be performed on an alternative weekday within the survey period.

10. Taxi Operation Survey

Traffic operation survey should be conducted at taxi hold areas (parking areas where taxis must wait before being sent to terminal frontages to pick up passengers on the arrivals level), taxi pocket areas (areas where taxis queue in the vicinity of the arrivals level frontage before reaching the taxi dispatch location and picking up fares), and at the curbside passenger pick-up areas. The survey should be conducted for a total of 15 hours on a weekday from 4:00 AM to 10:00 AM and from 1:00 PM to 10:00 PM for each terminal. The counts are to be summarized by 15-minute and hourly intervals.

The information is necessary to support the design team in identifying taxi hold sizing requirements. The data shall include in/out counts at taxi hold areas and queue length measurements at taxi pocket areas near terminal frontages. The information will also identify the maximum accumulation of taxis in the hold area to determine sizing needs.

The taxi volumes entering and exiting taxi hold areas can be obtained using a combination of automatic traffic recorder (ATR), video recordings and manual counts, and if available from the taxi hold dispatcher. The taxi hold dispatcher information should identify the terminal to which the taxi is sent.

At the curbside passenger pick-up areas, the time passengers need to wait to board a taxi and the length of the resulting passenger queue also needs to be recorded for a total of 15 hours on a weekday from 4:00 AM to 10:00 AM and from 1:00 PM to 10:00 PM. The counts are to be summarized by 15-minute and hourly intervals. The information should identify average and maximum queue lengths and durations.

The counts are to be performed for a typical weekday, free of major incidents. If the day the counts are conducted is deemed not to be a typical weekday, the counts shall be performed on an alternative weekday within the survey period.

11. Travel Speed Runs

A series of travel time runs should be performed along the main access routes to the airport from respective originating points outside of the CTA to midpoints located at the most attractive point along approach ramp to the arrival and departure frontage of each terminal. Control points need to be established at distinctive points along the frontage approach ramps. The travel time runs should end at a location outside of the CTA in the vicinity of the originating point. Thus, each run will record the travel time to the terminal and the travel time from the terminal for the selected route.

The travel times should be collected using the floating car method by traveling with general traffic during the weekday 6:00 AM to 10:00 AM and 4:00 PM to 8:00 PM peak hours for the airport and for the terminal frontages. The targeted number of runs per travel time route should be a minimum of two runs per terminal frontage peak hour. The travel time runs should be conducted using a combination of

GPS devices to store timestamps and record corresponding coordinates, and a manual travelogue to indicate speeds at particular locations, stop delay causes and times, and record travel speeds along the individual frontages. If the vehicle is stopped at a red traffic signal, the number of signal cycles to advance through the intersection should be recorded.

The travel time speed runs are to be performed for a typical weekday, free of major incidents. If the day, the counts are conducted is deemed not to be a typical weekday, the travel time speed runs shall be performed on an alternative weekday within the survey period.

	Van Wyck Expressway				JFK Expressway						
	Segment	# of Runs	Distance (mi)	Average Speed (mph)	Travel Time (min)	Segment	# of Runs	Distance (mi)	Average Speed (mph)	Travel Time (min)	
Terminal 8	Peak Hour 5:30AM-6:30AM Arrivals										
	Start - Airtrain	2	0.34	41	0.50						
	Airtrain - 1	2	1.40	49	1.74	Start - 1	2	0.95	41	1.41	
	1 - 8A.2	2	0.72	29	1.47	1 - 8A.2	2	0.21	36	0.35	
	8A.2 - 8A.3	2	0.25	11	1.28	8A.2 - 8A.3	2	0.21	11	1.32	
	8A.3 - 1	2	0.30	29	0.80	8A.3 - 1	2	0.47	30	0.98	
	1 - Airtrain	2	1.40	46	1.82	1 - End	2	0.97	42	1.41	
	Airtrain - End	-	-	-	-						
	Total				7.62	Total					5.47
	Peak Hour 5:30AM-6:30AM Departures										
	Start - Airtrain	2	0.37	45	0.47						
	Airtrain - 1	2	1.40	54	1.55	Start - 1	2	0.96	47	1.23	
	1 - 8D.2	2	0.74	38	1.17	1 - 8D.2	3	0.23	24	0.70	
	8D.2 - 8D.3	2	0.23	19	0.75	8D.2 - 8D.3	3	0.24	16	0.89	
	8D.3 - 1	2	0.70	25	1.71	8D.3 - 1	3	0.51	35	0.91	
	1 - Airtrain	2	1.40	55	1.54	1 - End	3	0.97	48	1.21	
	Airtrain - End	1	0.39	47	0.50						
Total				7.69	Total					4.94	

- Start - Southbound Van Wyck Expressway at Belt Parkway
Southbound JFK Expressway at 150th Avenue
- 1 - An All Terminal sign on the overpass structure along JFK Expy
All Terminal overhead sign structure along Van Wyck Expy
- Airtrain - Overhead Airtrain Tracks
- A2;A3 - Arrivals Frontage Entrance; Arrivals Frontage Exit
- D2;D3 - Departures Frontage Entrance; Departures Frontage Exit
- End - Northbound Van Wyck Expressway at Belt Parkway
Northbound JFK Expressway at 150th Avenue

Figure 84: Sample travel time study

4. AirTrain Passenger Survey

The AirTrain Passenger Count Survey shall be conducted at each AirTrain station using video recordings and field personnel and shall include the following:

a. Station Passenger Counts

The station passenger count data shall be collected over seven continuous 24-hour days during the survey period. The cameras shall record data, for each train line, at each station, in 5-minute intervals for the following:

- Total number of passengers entering the station, with or without a baggage cart;

- Number of passengers entering the station with a baggage cart;
- Total number of passengers exiting the station, with or without a baggage cart;
- Number of passengers exiting the station with a baggage cart;
- Percentage of employees entering and exiting the station; and,
- Total number of passengers boarding and alighting each AirTrain car by train line and collecting train arrival time for one weekday and one weekend day during the 6:00 AM to 10:00 AM and 4:00 PM to 8:00 PM peak periods.

AirTrain passengers shall be classified as employees if they wear a uniform or possess a visible ID. All other passengers shall be classified as non-employees. Passenger volumes shall be summarized in 15-minute and hourly intervals for each station.

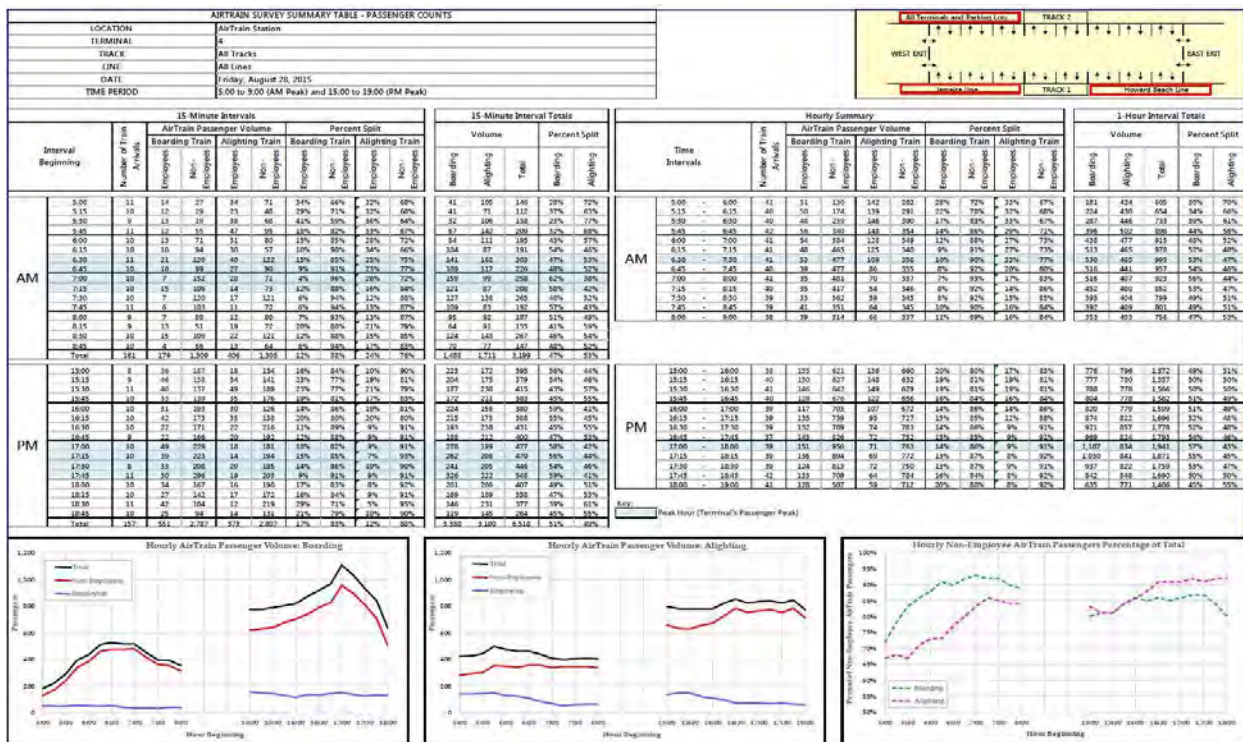


Figure 85: Sample format for AirTrain passenger count

b. Station Origin and Destination Counts (O-D Counts)

The station O-D counts shall be collected for one weekday from 12:00 AM through 11:59 PM. The following two actions are to be performed:

Distribute one color-coded 3" x 5" card to each passenger entering the station. Each station shall have a unique color card. Record the unique identifier sequence number of the cards distributed within each hour.

Collect color-coded 3" x 5" cards from as many passengers exiting station as practical. Do not record the time.

Data on the distribution of O-D survey cards shall be tabulated by station and hour using the unique identifier on each card. The O-D survey cards collected shall be sorted to determine the number of cards collected at each station in each hour of the survey. The counts are to be summarized by 15-minute and hourly intervals. A proper sample size for the survey must be provided for accuracy. The sample size must be submitted for approval prior to implementing the survey



Figure 86: Sample format for AirTrain link comparison

c. AirTrain Car Passenger Occupancy

The AirTrain car passenger occupancy data should be collected for one weekday and one weekend day during the 6:00 AM to 10:00 AM and 4:00 PM to 8:00 PM peak periods. The counts are to be summarized by 15-minute and hourly intervals. Data shall be recorded between every station stop for the following:

- Total number of passengers in the AirTrain car without baggage; and,
- Total number of passengers on the AirTrain car with baggage; including number of bags per passenger and baggage type.

d. AirTrain Headway, Dwell Time, and Passenger Congestion Counts

AirTrain headway and dwell time data shall be collected for each pair of adjacent AirTrain stations. The data will be collected simultaneously with the AirTrain passenger counts. The data shall be collected for one weekday and one weekend day during the 6:00 AM to 10:00 AM and 4:00 PM to 8:00 PM peak

periods. Data on start time, headway, and dwell time shall be collected for each train at each station in each direction of travel. Data shall be recorded in the format [hour: minute: second] to the nearest whole second, using a 24-hour clock [e.g., ISO standard 8601]. The counts are to be summarized by 15-minute and hourly intervals.

e. Station Queuing

Station queuing shall be recorded at each station for the number of passengers who are not able to board the AirTrain, while specifying the reason for each instance (e.g., train car capacity exceeded; station congestion, or other). This data shall also be collected simultaneously with the AirTrain passenger counts and the headway and dwell times. The information shall be recorded on the data collection forms under a column called “number of passengers left” with a “reason” column next to it. The counts are to be summarized by 15-minute and hourly intervals.

f. Event Log

A log of events per station shall be kept throughout the Survey Period to record any notable occurrences or anomalies including the time of occurrence and duration (e.g., AirTrain doors held open, AirTrain doors recycled, or other).

5. Air Passenger Interview Surveys

Airport Passenger Interview Surveys shall be conducted at each of the individual terminals to obtain information regarding air passenger characteristics such as arrival time before flight departure, airport access, trip origins, and the use of ground transportation modes. The direct interviewing of departing air passengers in the waiting areas at the departure gates and the baggage claim area for arriving passengers will be utilized to ensure the appropriate target audience responds to the survey and generates positive cooperation rates. A proper sample size for the survey must be provided for accuracy and submitted for approval prior to implementing the survey. The data shall be collected over two continuous weekdays during the 6:00 AM to 10:00 AM and 4:00 PM to 8:00 PM peak periods.

The surveys are to be performed for a typical weekday, free of major incidents. If the day, the counts are conducted is deemed not to be a typical weekday, the surveys shall be performed on an alternative weekday within the study period.

A sample interview form is shown below.

1. Type of Flight

International Flight
Domestic Flight

2. Purpose of Flight

Business
Pleasure

3. O/D Passenger Mode of Access

Private Car
Private Car parked at Airport
Rental Car
Taxi
Limousine/Town Car
Uber/Lyft
Super Shuttle/Shared Ride Van
Coach Bus
Train/Subway/AirTrain
Off-Airport Parking/Hotel Shuttle

4. Local Passenger Origin/Destination

Home Zip Number _____

5. Buffer Time Spent at Airport

Time at Airport prior to Flight (Departures) _____

Time at Airport after Flight (Arrivals) _____

6. Travel Group Size

Number of Air Passengers _____

Number of Visitors (did not fly) _____

Figure 87: Sample passenger survey form

6. Existing and Future Design Day Flight Schedules (DDFS)

Typically obtain from the airlines or the terminal developer, the DDFS identifies the terminal that the aircraft arrived to or departed from, aircraft arrival and departure times, aircraft capacity and aircraft load factor. Information on passenger type, origin/destination or transfer, also needs to be obtained. A sample DDFS and connection percentage matrix is shown below.

Operator	Equipment	Seats	ArrOrigin	ArrFlightNumber	ArrSchTime	DepDestination	DepFlightNumber	DepSchTime	Stand minutes	Arrival Market	Departure Market	Arrival Terminal	Departure Terminal	Arr Pax	Dep Pax
DL	78W	226	LAX	16	7/31/2014 16:48	LAX	427	7/31/2014 20:00	192	DOM	DOM	Terminal 4	Terminal 4	203	215
DL	78W	226	LAX	16	7/31/2014 17:48	LAX	427	7/31/2014 21:00	192	DOM	DOM	Terminal 4	Terminal 4	203	215
OS	772	308	AMS	639	7/30/2014 10:35	VIE	87	7/31/2014 13:55	1640	INT	INT	Terminal 1	Terminal 1	277	293
MU	346	324	PVG	587	7/30/2014 14:25	PVG	588	7/31/2014 16:25	1560	INT	INT	Terminal 1	Terminal 1	292	308
DL	764	246	ARN	203	7/30/2014 15:54	BOG	449	7/31/2014 12:30	1236	INT	INT	Terminal 4	Terminal 4	221	234
SU	77W	365	SVO	102	7/30/2014 17:20	SVO	103	7/31/2014 19:10	1550	INT	INT	Terminal 1	Terminal 1	329	347
AA	32B	102	SFO	164	7/30/2014 17:30	LAX	117	7/31/2014 15:00	1290	DOM	DOM	Terminal 8	Terminal 8	92	97
B6	E90	100	AUS	1094	7/30/2014 17:53	ROC	586	7/31/2014 09:44	951	DOM	DOM	Terminal 5	Terminal 5	90	95
AA	738	148	STT	1074	7/30/2014 18:00	POS	425	7/31/2014 00:55	415	DOM	INT	Terminal 8	Terminal 8	133	141
AA	32B	102	LAX	2	7/30/2014 18:00	LAX	3	7/31/2014 12:30	1110	DOM	DOM	Terminal 8	Terminal 8	92	97
B6	E90	100	BUF	2601	7/30/2014 18:04	AUS	795	7/31/2014 09:29	925	DOM	DOM	Terminal 5	Terminal 5	90	95
JL	788	186	NRT	4	7/30/2014 18:25	NRT	3	7/31/2014 09:40	915	INT	INT	Terminal 1	Terminal 1	167	177
B6	321	190	LAS	711	7/30/2014 18:59	PIJ	869	7/31/2014 08:20	801	DOM	INT	Terminal 5	Terminal 5	171	181
AA	738	148	SJL	1472	7/30/2014 19:00	PTY	807	7/31/2014 01:45	405	DOM	INT	Terminal 8	Terminal 8	133	141
AA	32B	102	LAX	172	7/30/2014 19:00	LAX	19	7/31/2014 11:00	960	DOM	DOM	Terminal 8	Terminal 8	92	97
DL	321	190	SEA	1473	7/30/2014 19:11	BOS	439	7/31/2014 12:59	1068	DOM	DOM	Terminal 4	Terminal 4	171	181
DL	73H	160	LAS	2658	7/30/2014 19:20	SLC	463	7/31/2014 11:52	992	DOM	DOM	Terminal 4	Terminal 4	144	152
B6	E90	100	BOS	1317	7/30/2014 19:24	BTW	1634	7/31/2014 09:19	835	DOM	DOM	Terminal 5	Terminal 5	90	95
9E	CR9	76	SAV	3319	7/30/2014 19:29	DDU	2932	7/31/2014 08:30	781	DOM	DOM	Terminal 4	Terminal 4	68	72
AA	320	150	RDU	3295	7/30/2014 19:30	DCA	3225	7/31/2014 11:00	930	DOM	DOM	Terminal 8	Terminal 8	135	143
9E	CR9	76	IAD	6127	7/30/2014 19:30	BUF	2906	7/31/2014 08:15	765	DOM	DOM	Terminal 4	Terminal 4	68	72
9E	CR9	76	DTW	3364	7/30/2014 19:35	CHS	2952	7/31/2014 08:10	755	DOM	DOM	Terminal 4	Terminal 4	68	72
AA	738	150	DCA	1029	7/30/2014 19:40	MIA	1085	7/31/2014 09:00	800	DOM	DOM	Terminal 8	Terminal 8	135	143
9E	CR9	76	DCA	3394	7/30/2014 19:40	ACK	2975	7/31/2014 08:05	745	DOM	DOM	Terminal 4	Terminal 4	68	72
9E	CR9	76	CMH	6068	7/30/2014 19:40	MSY	2888	7/31/2014 08:10	750	DOM	DOM	Terminal 4	Terminal 4	68	72
DL	73H	160	STI	327	7/30/2014 19:49	SAN	2506	7/31/2014 10:20	871	INT	DOM	Terminal 4	Terminal 4	144	152
AA	32B	102	LAX	12	7/30/2014 20:00	SFO	179	7/31/2014 10:30	870	DOM	DOM	Terminal 8	Terminal 8	92	97
B6	E90	100	ORD	606	7/30/2014 20:00	SYR	116	7/31/2014 09:10	750	DOM	DOM	Terminal 5	Terminal 5	90	95
DL	321	190	SFO	468	7/30/2014 20:02	SFO	432	7/31/2014 11:45	943	DOM	DOM	Terminal 4	Terminal 4	171	181
CX	77W	275	YVR	889	7/30/2014 20:10	HKG	845	7/31/2014 01:30	320	PRE	INT	Terminal 7	Terminal 7	248	261
B6	321	190	SDQ	410	7/30/2014 20:15	MCO	583	7/31/2014 06:00	585	INT	DOM	Terminal 5	Terminal 5	171	181
9E	CR9	76	ROC	6144	7/30/2014 20:15	JAX	2919	7/31/2014 08:00	705	DOM	DOM	Terminal 4	Terminal 4	68	72

Figure 88: Sample DDFS format

Operation Type	Origination / Destination	Connection	Load Factor
DAL - International / Pre-cleared	57.70%	42.30%	90%
DAL - Domestic Mainline	85.92%	14.08%	90%
DAL - Regional Jet	55.10%	44.90%	90%
IAT - International/ Domestic	90.00%	10.00%	90%

Source: Phase 3 Delta JFK IAT Planning Assumptions provided by Delta

Figure 89: Sample O&D and connection profiles

7. Passenger Arrival Curves at the Frontage

The distribution of time before/after flight departure/arrival times that passengers arrive to the frontage is referred to as a frontage arrival curve. These are typically obtained from air passenger interview surveys, the airlines, or the terminal developer. Originating passengers arrive at the airport before their departing flight allowing time for check-in, security screening, concessions, and flight boarding. Terminating passengers deplane and traverse the terminal to collect their checked bags if any at baggage claims. Terminating passengers will then proceed to the curbside based on their transportation need.

Minutes Before Scheduled Departure	Domestic Arrivals	International Arrivals
15-30	0.93%	0.24%
30-45	2.87%	0.47%
45-60	7.04%	1.17%
60-75	15.00%	4.39%
75-90	17.97%	7.47%
90-105	15.73%	11.00%
105-120	11.64%	13.17%
120-135	7.79%	14.23%
135-150	5.20%	12.19%
150-165	3.28%	9.08%
165-180	2.06%	6.28%
180-195	1.41%	4.43%
195-210	1.08%	3.20%
210-225	0.67%	2.30%
225-240	0.64%	1.76%
240-255	0.45%	1.10%
255-270	0.35%	0.98%
270-285	0.28%	0.69%
285+	5.61%	5.85%

Source: Phase 3 Delta JFK IAT Planning Assumptions provided by Delta

Figure 90: Sample show-up profile

	Departures		Arrivals	
	AM Period (5 to 9 AM)	PM Period (3 to 7 PM)	AM Period (5 to 9 AM)	PM Period (3 to 7 PM)
Frontage [1]	77%	69%	62%	64%
Air-Train Utilization [2]	16%	27%	24%	20%
Straight to Parking [3]	7%	4%	14%	16%

[1] Includes passengers from curb-and-park operations and passengers from vehicles that enter the parking lot via the recirculation entrance after unsuccessful attempts to use the curb

[2] Peak hour AirTrain utilization

[3] Straight to parking pax percentages during the 4-hour period

Figure 91: Sample air passenger distribution

8. Traffic Volume Forecasting Methodology

a. Existing Traffic Volume Forecast

Before developing traffic volume forecasts for the future analysis years, existing traffic volumes are forecast at each of the terminal frontages by converting air passenger volumes derived from the existing (base case) condition DDFS into traffic volumes and comparing the projected volumes to traffic volume count data.

The existing DDFS flight schedule includes air passenger volumes, which take into account load factors (the percentage of seats occupied on flights) and transfer rates (the percentage of passengers connecting to other flights that are not originating or departing [O-D] passengers). The air passengers at the gate need to be adjusted with the frontage arrivals curves to account for the time distribution of departing passengers at the departures level frontage before their scheduled flight departure time and the time distribution of arriving passengers at the arrivals level frontage after their scheduled flight arrival time.

Different distributions are used for each terminal based on data obtained from the Air Passenger Survey. Separate arrival distributions are used for each terminal for flights departing before or after 9:00 AM.

Modal split, vehicle occupancy, and vehicle influence (vehicle length by mode type) data from the Data Collection Program and the Air Passenger Survey are used to convert the air passenger volumes at the terminal curbsides into vehicular volumes for autos, taxis and limos/for-hire vehicles. The number of autos, taxis and limos/for-hire vehicles at the curb is determined by subtracting autos that go directly to parking with further adjustments for re-circulation traffic. Existing volumes for other vehicle types (including buses) are obtained from vehicle classification counts conducted at the terminal curbsides. Adjustment factors are then developed to calibrate the existing traffic volume forecasts to existing traffic volume count data recorded in the Data Collection Program.

Using the vehicular O/D data obtain from the Data Collection Program and the Air Passenger Survey, the calibrated forecasted vehicle at the curb volume, vehicle to/from parking and re-circulation traffic are than applied the airport roadway network and compared to the balanced flow map generated from the ground counts. Additional calibration factors are then applied, as necessary, to converge the two data sets.

Convergence should be determined through use of a GEH Statistic to avoids pitfalls that occur when using simple percentages to compare two sets of volumes. This is because the traffic volumes in the real world vary over a wide range. For example, the mainline of a freeway might carry 5000 vehicles per hour, while one of the on-ramps leading to the freeway might carry only 50 vehicles per hour (in that situation it would not be possible to select a single percentage of variation that is acceptable for both volumes). The GEH statistic reduces this problem; because the GEH statistic is non-linear, a single acceptance threshold based on GEH can be used over a fairly wide range of traffic volumes

For establishing the "baseline" scenario, a GEH of less than 5.0 is considered a good match between the projected and observed hourly volumes (flows of longer or shorter durations should be converted to hourly equivalents to use these thresholds). As a minimum, 85% of the volumes in a traffic model should have a GEH less than 5.0. GEHs in the range of 5.0 to 10.0 warrant investigation. If the GEH is greater than 10.0, there is a high probability that there is a problem with either the forecast volumes or the

count data (this could be something as simple as a data entry error, or a complication forecast calculations.

b. Future Traffic Volume Forecast

Traffic volume forecasts for the future analysis years are calculated in a similar manner using the DDFS for each terminal, which also takes into account load factors and transfer rates. Passenger volumes are converted into vehicular volumes for autos, taxis and limos/for-hire vehicles using the existing modal split and vehicle occupancy data and the same adjustment factors used to calibrate the existing forecasts; traffic volumes for other vehicle modes (including scheduled buses, courtesy vehicles, on-airport buses, public transit buses, delivery vehicles, authorized vehicles and other vehicles) are increased using a projected annual background growth rate.

Growth factors are developed by dividing the future traffic volume forecasts by the existing traffic volume forecasts at each of the terminal frontages for hourly periods in rolling 10-minute intervals. Traffic volumes for each of the hourly periods in the future analysis year are then projected by multiplying the existing Base Year balanced traffic volumes by the corresponding growth factors, which are prorated to reflect growth occurring from existing to the future analysis year.

9. Existing Conditions (Base Case) Simulation Model Calibration

This section defines and describes the development process and strategies for the VISSIM model that will be used to analyze the landside facilities within the airport. The VISSIM model will be developed and simulated with two separate but integrated components; a Dynamic Traffic Assignment model and a Static Traffic Assignment model.

Dynamic traffic assignment performs the traffic assignment to select optimal travel routes from an origin point to destination point and, in turn, transmits the collected routes to the static traffic assignment for visual simulation and network performance assessment (i.e., curbside activities, vehicle dwell times, number of vehicles double parked, or the recurrence of vehicle circulating). Static traffic assignment will also be applied public transit, courtesy vehicles and on-/off-airport buses based on the fact that each transit vehicle will operate on a fixed time table which is defined by headway and makes regular stops at designated stopping areas.

The parameters of the existing condition or base case model shall initially be calibrated to match field data, measurements, and other observations so that the simulation can be used to accurately depict operating conditions in future analysis scenarios. The model calibration process involved comparisons and adjustments of simulated overall traffic volumes, dwell times at the terminal curbsides, total travel times for bus routes, and queuing caused by lane blockages or traffic congestion.

Convergence shall be determined through use of a GEH Statistic to avoid pitfalls that occur when using simple percentages to compare two sets of volumes. This is because the traffic volumes in the real world vary over a wide range. For example, the mainline of a freeway might carry 5000 vehicles per hour, while one of the on-ramps leading to the freeway might carry only 50 vehicles per hour (in that situation it would not be possible to select a single percentage of variation that is acceptable for both volumes). The GEH statistic reduces this problem; because the GEH statistic is non-linear, a single acceptance threshold based on GEH can be used over a fairly wide range of traffic volumes

For establishing the "baseline" scenario, a GEH of less than 5.0 is considered a good match between the projected and observed hourly volumes (flows of longer or shorter durations should be converted to hourly equivalents to use these thresholds). As a minimum, 85% of the volumes in a traffic model should have a GEH less than 5.0. GEHs in the range of 5.0 to 10.0 warrant investigation. If the GEH is greater than 10.0, there is a high probability that there is a problem with either the forecast volumes or the count data (this could be something as simple as a data entry error, or a complication within the simulation model).

The VISSIM model developed and calibrated for the Existing Condition shall be used as the basis for development of the Future No Build Condition and Build Condition models.

a. Model Construction

A traffic simulation model first needs to be constructed for the Existing Condition based on traffic volumes for both the 6:00 AM to 10:00 AM and 4:00 PM to 8:00 PM peak periods which includes the peak hour with the airport's highest overall traffic volumes. The VISSIM model consists of all of the major roadways leading to/from the airport, the airport internal circulation roads, the terminal approach ramps including the terminal arrivals and departures.

b. Roadway Network

VISSIM uses a line and polygon layered network. Lines define the physical roadway geometry and polygons define decision points such as an intersection or on/off ramps. This feature representation allows for network coding in a link/connector fashion, which is the most feasible to code and model complex roadway geometries. Roadway links can be traced from aerial photo that are imported into VISSIM as a background image, and further refined with AutoCAD drawings to ensure link distances are reasonably accurate coded with information such as the number and width of lanes, vehicle speeds, and traffic control devices such as signals and stop signs.

c. Trip Tables

The Balanced Flow maps and Origin/Destination (O/D) trip table matrices are estimated based on field observed traffic volumes, the breakdown of vehicle classes collected from the data collection program and the air passenger survey information. Trip tables are prepared individually for each terminal frontage and parking garage. Subsequently, traffic volume flow maps are prepared for the entire airport and individual quadrants. The study area's outer boundaries are modeled as external stations where external stations are treated as exit and entry points for access to and from the airport.

d. Access Mode, Destination and Stop Choice

There are two primary modes accessing the airport autos and public transit. Auto consists of private automobiles, taxis, for-hire and TNC vehicles. Public Transit includes public transit buses; courtesy vehicles; on-airport buses; and, off-airport buses.

The auto mode has multiple possible stops and destinations including frontage roadways, parking facilities, cell phone lots and taxi/TNC hold areas. A trip with multiple stops is referred to as "trip chaining." Private autos with destinations to frontage roadways are assigned the same final destination as point of origin except for those re-routed to a parking lot after dropping off passengers. Autos destined to parking without stopping at frontage roadways remain at the lot/garage during the course of the simulation run, and return trips leaving parking lots were developed based on exit statistics

collected for each lot. All incoming taxis are re-routed to the taxi hold after passengers are dropped off, except deadhead trips which were assigned to the taxi hold directly. Prior to pick-up TNC vehicles must first go to a centralized hold or staging area with geofence boundaries. Cell phone lot users are simulated in a similar fashion,

e. Transit Routing and Assignment

Transit trips should be coded in VISSIM with static assignment based on the fact that each transit vehicle will operate on a fixed time table which is defined by headway and makes regular stops at designated stopping areas. For the airport models, it should be assumed that all transit vehicles will adhere to the assigned headway and make regular stops.

f. Dynamic Assignment

A dynamic assignment process shall be utilized to allow VISSIM to determine the optimal route for each vehicle to access the airport landside facilities. Dynamic assignment also helped to identify potential deficiencies in the roadway configuration which can cause bottlenecks and congestion. The dynamic assignment is also the key component in the process to determine route choices for static simulation to analyze the terminal frontage roadway activities such as double parking, vehicle recirculation, dwell time reinforcement and interaction of vehicles at the operational level.

g. Terminal Curbside Activities

Typically, on-street parking has designed parking spaces with proper markings and spatial layouts to allow a driver to maneuver in and out without hindering adjacent vehicles. Curbside parking, on airport roadways, generally does not have these spatial layouts except where designated for bus stops, taxi stands courtesy vehicle waiting areas. Private auto drivers will generally randomly park along the curbside as a space becomes available.

As demand outpaces supply, these drivers will double park. This creates a dynamic environment where parking rules are difficult to enforce and parking capacity is very difficult to quantify. As a driver approached the terminal roadway, they would slow down to look for any available parking space. Spaces in Lane 1 closest to the curbside will be filled first followed by Lane 2.

To reasonably replicate these activities, it will necessary to develop design speed profiles for each roadway to regulate travel speeds, and assign a hierarchy of attractiveness associated with cost to each curbside parking space. Spaces closest to terminal doorways are the most attractive, and the attractiveness decreases as the distance becomes further away from the terminal doorways and further away for the curbside.

h. Re-Circulation Traffic

Recirculation behavior at the frontages is based on a number of factors. The first factor is the number of available spaces at the destination frontage, which is determined using a combination of frontage lengths, individual parking space length, and the average dwell time of vehicles at the frontage. The second factor is the attractiveness of available spaces at the destination frontage. For example, curbside spaces are considered to be more attractive than spaces in the second or third lanes. Additionally, spaces physically located near the terminal doorways are considered to be more attractive.

If the frontage is too crowded and none of the spaces available at the frontage are sufficiently attractive, vehicles will skip parking at the frontage and to circle back via recirculation roadway. Vehicles that have made at least three attempts but cannot access the frontage curb will divert to the closest parking facility.

i. Critical Link Volume and Speed Comparison

To capture the true peaking characteristic, it will be necessary to simulate for both the 6:00 AM to 10:00 AM and 4:00 PM to 8:00 PM peak periods instead of peak hours. By simulating peak periods, the hours before the peak hour helped preload the network with traffic. The purpose of using dynamic assignment is to allow vehicles to travel from point A to point B in the shortest travel time, least distance traveled and at minimum cost. To reasonably reflect driver behavior, multiple assignments must be run to allow the model to converge based on travel time where variation is within 15% between successive runs. This would set the parameter for each driver to be familiar with the roadway network.

The VISSIM generated travel times and travel speeds along specific routes are compared with actual speed runs. In addition to auto travel time and travel speed, courtesy bus and airline connection bus travel times are calibrated against field observations. It was not necessary to calibrate vehicle dwell time and double parking. Dwell time is a direct input from field observations, and double parking is subject to availability which is a function of individual vehicle dwell time.

j. Measurement of Effectiveness (MOE)

VISSIM contains post processing procedures which provided an interface with GIS based mapping. These procedures provide custom formats in an Excel spreadsheet for the MOE summary as well as for bar charts and pie charts for graphical displays. The MOEs should be collected to include items such as: density, average speed, levels-of-service for multilane roadways, travel times along critical airport segments, frontage levels of service and vehicle delays, queue lengths on the frontage approach roadways, intersection delays by movement, intersection queue lengths by movement, and queue lengths in taxi hold areas.

10. Level-of-Service Performance Measures for Airport Terminal Access and Circulation Roadways

The key performance measures defining the level of service of an airport terminal area roadway are as follows:

- Average speed, which determines travel time;
- Traffic density, which determines the ability of motorists to easily maneuver into and out of travel lanes;
- Maximum volume-to-capacity (v/c) ratio, which indicates how close the roadway is to breakdown and is useful for determining other performance measures such as queue length and delays; and,
- Duration and length of queues.

With the exception of weaving analysis, the definitions and metrics presented in the 2010 HCM are applicable to airport roadways with un-interrupted operations and signalized or un-signalized (i.e., stop-sign controlled) intersections.

Criteria	Levels of Service				
	A	B	C	D	E
Free-flow speed = 50 mph					
Minimum speed (mph)	50	50	50	48.9	47.5
Maximum volume/capacity ratio	0.28	0.45	0.65	0.86	1
Maximum service flow rate (passenger cars/hour/lane)	550	900	1300	1710	200
Maximum flow (vehicles/hour/lane) (a)	440	730	1050	1380	1620
Free-flow speed = 45 mph					
Minimum speed (mph)	45	45	45	44.4	42.2
Maximum volume/capacity ratio	0.26	0.43	0.63	0.82	1
Maximum service flow rate (passenger cars/hour/lane)	490	810	1170	1500	1900
Maximum flow (vehicles/hour/lane) (a)	400	650	940	1250	1530
Free-flow speed = 40 mph					
Minimum speed (mph)	40	40	40	39	38
Maximum volume/capacity ratio	0.26	0.42	0.61	0.82	1
Maximum service flow rate (passenger cars/hour/lane)	450	740	1060	1400	1750
Maximum flow (vehicles/hour/lane) (a)	360	600	860	1130	1410
Free-flow speed = 35 mph					
Minimum speed (mph)	35	35	34	34	33
Maximum volume/capacity ratio	0.26	0.42	0.61	0.8	1
Maximum service flow rate (passenger cars/hour/lane)	410	670	980	1280	1600
Maximum flow (vehicles/hour/lane) (a)	330	540	790	1030	1290
Free-flow speed = 30 mph					
Minimum speed (mph)	30	30	30	29.6	29
Maximum volume/capacity ratio	0.26	0.41	0.6	0.79	1
Maximum service flow rate (passenger cars/hour/lane)	370	600	870	1150	1450
Maximum flow (vehicles/hour/lane) (a)	300	480	700	930	1170
Free-flow speed = 25 mph					
Minimum speed (mph)	24	25	25	24.8	24
Maximum volume/capacity ratio	0.25	0.4	0.59	0.79	1
Maximum service flow rate (passenger cars/hour/lane)	310	500	740	900	1250
Maximum flow (vehicles/hour/lane) (a)	250	400	600	800	1010

mph = miles per hour

(a) Flow rates adjusted to account for 0.95 heavy vehicle factor and 0.85 driver population factor due to occasional or unfamiliar users.

Source: ACRP Report 40: Airport Curbside and Terminal Area Roadway Operations.

Figure 92: LOS criteria for terminal roadways

a. Low Speed Airport Roadway Weaving Analysis

The operation of weaving and merging areas on airport roadways differs from the operation on non-airport roadways primarily because these operations occur at slower speeds on airport roadways than they do on freeways and arterial streets. The weaving analysis methodology outlined in 2010 HCM was developed for freeways and arterial streets on which vehicles operate at higher speeds than those on most airport roadways.

Although motorists on airport roadways are traveling at speeds (e.g., 35 mph or less) that are slower than those on freeways or arterial roadways, the limited distances between decision points compromise the ability of motorists to recognize, read, and react to roadway guide signs, or do not allow adequate time to complete required merging and weaving maneuvers.

All weaving analyses shall be done in accordance with the definitions and metrics outlined in ACRP Report 40: Airport Curbside and Terminal Area Roadway Operations.

Level of Service	Freeway Weaving Segment (pc/mi/ln)	Collector-Distributor Roadway (pc/mi/ln)	Airport Low-Speed Roadway (pc/mi/ln)
A	10	12	20
B	20	24	30
C	28	32	40
D	35	36	50
E	>35	>36	60
F	v/c>1.0	v/c>1.0	v/c>1.0

Notes: pc/mi/ln = passenger cars per mile per lane.

If the density exceeds the LOS threshold, then the roadway is over capacity.

Source: ACRP Report 40: Airport Curbside and Terminal Area Roadway Operations.

Figure 93: LOS criteria for weaving segments

11. Terminal Curbside Frontage

In evaluating airport curbside roadway operations, analyses of both the curbside lanes (where motorists stop to pick up or drop off passengers) and the adjacent through lanes are required. These analyses are necessary because double- or triple-parked vehicles impede or delay the flow of vehicles in the adjacent through lanes. As a result, the capacity of the through lanes decreases as demand for curbside space approaches or exceeds the capacity of a curbside roadway segment, causing double or triple parking.

After removing transfer passengers from the arrival and departure curves, the distribution of passengers at the curb, direct to/from parking, and those using the light rail system (AirTrain) need to be determined to complete the curbside frontage calculations.

All terminal curbside frontage analyses shall be done in accordance with the definitions and metrics outlined in ACRP Report 40: Airport Curbside and Terminal Area Roadway Operations.

A utilization factor of 0.90 or less is the desirable planning target for new curbside roadways.

A utilization factor of 1.30 (65% of the combined capacity of the inner and second curbside lanes) is acceptable for existing facilities, recognizing that during peak hours and days of the year, demand will exceed capacity.

Criteria	Airport Curbside Levels of Service					
	A	B	C	D	E	F
When double (and triple) parking is allowed at the curbside						
Maximum demand for curbside standing or parking/effective curbside length (a)	0.90	1.10	1.30	1.70	2.00	>2.00
Maximum service flow rate						
5-lane curbside roadway (vph)	3,400	3,280	3,100	2,710	2,400	Up to 2,400
4-lane curbside roadway (vph)	2,830	2,790	2,680	2,220	1,800	Up to 1,800
3-lane curbside roadway (vph)	2,200	1,950	1,580	860	750	Up to 750
When double parking is prohibited at the curbside						
Maximum demand for curbside standing or parking/effective curbside length (a)	0.70	0.85	1.00	1.20	1.35	>1.35
Maximum service flow rate						
4-lane curbside roadway (vph)	2,830	2,830	2,800	2,730	2,600	Up to 2,600
3-lane curbside roadway (vph)	2,350	2,250	2,000	1,760	1,600	Up to 1,600
Maximum through lane volume to capacity ratio	0.25	0.40	0.60	0.80	1.00	1.00

vph = vehicles per hour

(a) The ratio between the calculated curbside demand and the available effective curbside length.

Source: ACRP Report 40: Airport Curbside and Terminal Area Roadway Operations.

Figure 94: LOS criteria for airport curbside roadways

12. 3-D Visualization

Links and connectors in the VISSIM model are initially created in a 2D environment. At the terminal curbsides, the arrivals level (upper level) are slightly offset from the departures level (lower level) to permit both roadways to be simultaneously viewed in 2D. The 3D modeling environment is developed by adding elevations to the roadway links and shifting the departures level on top of the arrivals level at the terminal curbsides.

VISSIM includes a library of basic static and dynamic 3D objects. To improve the 3D visualization of the VISSIM model for presentation purposes, static 3D scenery objects specific to the airport may need to be developed. Many of the airport terminals and other buildings can be created by extruding the building outlines from the CAD drawings. Additional 3D objects such as overhead sign gantries, trees, sidewalks, railings, and bollards placed at the terminal curbsides and the other parts of the study area should be modeled in detail. To provide a more realistic experience, all the overhead signs to, within and from the airport, and much of the posted mounted signs along all terminals can be photographed. These photos can then be integrated into the VISSIM model.

The 3D modeling environment ultimately will be used to create screenshots and video clips of traffic conditions at the terminal curbsides as well as the overall traffic within study area.

13. Future Condition Analysis

Because the proposed development will take place in the future, the development environmental setting is not the current environment, but the environment, as it will exist at project completion, in the future. Therefore, future conditions must be projected. This prediction is made for a particular year, generally known as the "build year." The build year is the year when the development will be substantially operational, since this is when the development's effects will begin to be felt, and when mitigation of project impacts would have to be in place.

The assessment of existing conditions establishes a baseline, not against which the project is measured, but from which future conditions can be projected. The prediction of future conditions begins with an assessment of existing conditions because these can be measured, observed, and otherwise tested in the field.

14. Future No Build Condition

The existing environmental setting is used to project future conditions without the proposed action. This prediction is made for the year the action would be completed using the data about existing conditions together with information about expected future growth and developments. The scenario of the future without the proposed action, often referred to as the "no action" or "no build" condition, provides a baseline condition against which the incremental changes generated by the project can be evaluated. This sets the context in which to assess impacts.

Using existing conditions as a baseline allows the prediction of the future to a certain level of accuracy. Altogether, the no action analysis takes the existing observed condition and adds to it known or expected changes to arrive at a reasonable estimate of the future.

15. Future Build Condition

The future with the proposed action, also known as the "build" or "action" condition, is assessed and compared with the no action scenario. This assessment is performed for the same technical areas, using the same study areas, as the existing and no action assessments.

Many technical areas provide thresholds for what constitutes a significant impact; others require a more judgmental and qualitative assessment. Both qualitative and quantitative information is used, where possible, to determine the likelihood that the impact would occur, the timeframe in which it would occur, and its significance. Where no quantitative thresholds exist, a determination of significance must consider magnitude, duration, geographic scope, and irreversibility.

Part 3 - Landside Conceptual Design Criteria

1. Standards and References

- a. AASHTO: A Policy on Geometric Design of Highway and Streets
- a. AASHTO: Roadside Design Guide
- b. AASHTO: Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals
- c. Americans with Disabilities Act (ADA) Applicable Standards and Guidelines
- d. FHWA: Manual on Uniform Traffic Control Devices (MUTCD)
- e. PANYNJ Traffic Engineering Design Guidelines
- f. PANYNJ Civil Engineering Design Guidelines
- g. PANYNJ Civil Standard Details and Specifications
- h. PANYNJ Sustainable Infrastructure Guidelines
- i. PANYNJ Intersection Signalization Procedure
- j. PANYNJ Roadside and Median Barrier Design Manual
- k. PANYNJ Airport Roadway Sign Design Manual
- l. PANYNJ Manual for Pedestrian Signing and Wayfinding
- m. PANYNJ Intelligent Transportation System Design Guidelines

2. Scope

The roadway network shall be designed in accordance with the latest PANYNJ Engineering Design guidelines, as well as, current AASHTO standards/guidelines. The designs shall take into account the existing conditions; coordination with other landside improvements and impacts to existing and future utilities and provide right of way to accommodate a potential future light rail system. The overall terminal site design will impact a significant portion of the landside area, requiring a combination of new utility construction or relocation as necessary.

3. Roadway Geometrics

- a. Landside roadway horizontal and vertical geometry shall be in conformance with AASHTO: A Policy on Geometric Design of Highway and Streets requirements and the PANYNJ Civil Engineering Design Guidelines. The design speed for the terminal access roadway shall be 35 miles per hour. The design speed for the frontage approach ramps shall be 25 mph.
- b. Per PANYNJ Civil Engineering Design Guidelines, landside roadway drainage shall be design for 10-year rainfall return period and the gutter flow shall not encompass more than 1/3 the traveled lane.
- c. Sight distances for each of the roadway speeds will meet the standards of Section 3.2.1 AASHTO: A Policy on Geometric Design of Highway and Streets.
- d. Minimum horizontal offset to structures for roadway design will conform to the Barriers & Clear Zones section of AASHTO: A Policy on Geometric Design of Highway and Streets.
- e. Roadways have shall designed to meet provision for passing a stalled vehicle as per AASHTO: A Policy on Geometric Design of Highways and Streets.
- f. All lane drops and merge lanes are designed to meet the minimum standards following the MUTCD, Advanced Warnings and Taper and in consultation with PANYNJ.

- g. Curve widening will be applied over the length of the horizontal transition curve. The design widths for curve widening will be for both the super elevation runoff length as well as required sight distance per AASHTO: A Policy on Geometric Design of Highway and Streets.
- h. Maintain proper roadway clear zone free of obstruction where possible but as a minimum must comply with AASHTO: Roadside Design Guide. Proper protection shall be provided in accordance with the PANYNJ Roadside and Median Barrier Design Guide for areas where clear zone cannot be met. Protection shall include use of concrete barriers and/or guiderail. Impact attenuators shall be used at gore areas of diverging roadways on-structures and on-grade. On structures fixed objects shall be located behind the structure rail
- i. Per AASHTO: A Policy on Geometric Design of Highway and Streets, Table 3-7 Minimum roadway radii:

- R = 86.0' for 20 mph design speed
- R = 154.0' for 25 mph design speed
- R = 250.0' for 30 mph design speed
- R = 371.0 for 35 mph design speed
- R = 533.0 for 40 mph design speed

- i. Per PANYNJ Civil Engineering Design Guidelines, the maximum super elevation shall be 4%.
- j. Per PANYNJ Civil Engineering Design Guidelines, the maximum vertical grade for roadways shall be 5%. Grades greater than 5% must be approved by the PANYNJ Chief Civil Engineer.
- k. Design Vehicles

- a. Airport Roadway Network: 53 Ton Striker 4500 Fire Fighting Truck
- b. Loading Docks: WB 62
- c. Restricted Access Roads: 53 Ton Striker 4500 Fire Fighting Truck

- l. Vertical Clearance

- Roadway - 14.5 ft.
- Overhead Sign Structure - 15.5 ft.
- Overhead traffic Signal - 15.5 ft. minimum; 17.5 ft. maximum
- Above Heavy/Light Rail - 13.0 ft. minimum

- m. On-Airport Roadway Widths (Tangent Section)

- 4 Lanes = 54 Ft. (4-12 Ft. lanes; 2-3 Ft. shoulders)
- 3 Lanes = 42 Ft. (3-12 Ft. lanes; 2-3 Ft. shoulders)
- 2 Lanes = 30 Ft. (2-12 Ft. lanes; 2-3 Ft. shoulders)
- 1 Lane = 21 Ft. (1-15 Ft. lane; 2-3 Ft. shoulders)

- n. Roadway pavement shall be designed in accordance with the PANYNJ Civil Engineering Design Guidelines.

4. Terminal Frontage Roadway Layout

- a. The design speed for the Departure (upper level) and Arrivals (lower level) frontage roadways shall be 20 mph.
- b. Arrivals and Departures frontage roadways shall be 49 feet wide and shall consist of two 10-foot drop-off/pick-up lanes, one 12-foot maneuvering lane, two 12-foot bypass lanes and one 3-foot outer shoulder.

- c. The Ground Level HOV frontage shall be 52 feet wide and shall consist of two 10-foot drop off/pick up lanes, one 12-foot maneuvering lane, a striped 3-foot median, two 12-foot bypass lanes, and one 3-foot outer shoulder.
- d. Arrivals frontage length requirements shall be determined in accordance with the procedures outlined in this document
- e. The Departures frontage roadway length requirements shall be determined in accordance with the procedures outline in this document.
- f. Vertical clearance shall be a minimum of 14.5 feet.
- g. The minimum lateral distance between the terminal face and the right frontage curb shall be 30 feet.
- h. Pedestrian islands shall be a minimum of 30 feet wide.

5. Surface and Structural Parking

- a. Regular Parking Stall Dimensions shall be minimum 8.5 feet by 18 feet (width by length).
- b. Regular ADA Parking Stall Dimensions shall be minimum 8.5 feet by 18 feet (width by length) with at least one 5-foot-wide aisle parallel to each stall. The pedestrian aisle shall be marked and shall be of equal length to the stall.
- c. Van Accessible ADA Parking Stall Dimensions shall be minimum 11 feet by 18 feet with at least one 5-foot side aisle parallel to each stall. The pedestrian aisle shall be marked and shall be of equal length to the stall.
- d. Parking Drive Aisles shall be minimum 24 feet wide for two-way drive aisle, 20 feet wide minimum for one-way drive aisles.
- e. Entry and Exit Plazas
 - 1. Each entrance/exit lane shall be a minimum of 15 feet wide (9-foot travel lane and 6-foot island)
 - 2. Each entrance lane shall be located on a tangent a minimum of 46 feet long
 - 3. Each exit lane shall be located on a tangent a minimum of 54 feet long
 - 4. Entrance/exit plaza tapers shall be a minimum of 1 to 15
 - 5. Each exit lane shall be cash, credit card, E-Z pass and unmanned credit card or pre-paid capable
 - 6. Exit/entrance queues shall not extend onto adjacent roadways or circulation aisles.
 - 7. Controlled entrance lanes typically have a processing rate of 360 vehicles per hour.
 - 8. Controlled cash/credit card exit lanes typically have a processing rate of 110 vehicles per hour.
 - 9. E-Z Pass controlled exit lanes typically have a processing rate of 150 vehicles per hour

6. Garage Requirements

- a. Circulation aisles and ramps shall be a minimum of 24 feet wide
- b. Minimum vertical clearance for parking structures is eight feet (8.0 feet) at typical floors and twelve feet six inches (12 ft. 6in.) for ground floor

- c. Grade for parking structure ramps should range between six percent (6%) and ten percent (10%) without parking and maximum five percent (5%) and preferred three percent (3%) with parking.

7. Landside Signs and Support Structures

- a. Airport signs will allow motorists to safely navigate the airport roadway network while entering, transiting and exiting the terminal area, from local streets and highway corridor. This signage will include guide signs, regulatory signs, warning signs, informational signs, pedestrian wayfinding signs and possibly variable message sign technology.
- b. Roadway, parking and wayfinding signs shall meet the requirements of the MUTCD, PANYNJ Roadway Sign Manual, and the PANYNJ Manual for Pedestrian Signing & Wayfinding.
- c. Lateral and vertical clearances between sign panels and the roadway shall conform to PANYNJ Traffic Engineering Standards.
- d. Roadway signs shall be mounted on a single pole, or on overhead sign structure. Structural design of overhead sign structures shall conform to the latest AASHTO requirements.
- e. At this level of conceptual design, the main focus shall be the location of critical informational and guide signs and not the signs designs.

8. Traffic Signals

- a. Traffic signal locations shall be identified based on the signal warrants specified in the MUTCD.
- b. The traffic signal designs shall be developed using the PANYNJ Traffic Signal Design and Drawing Preparation Guidelines.
- c. At this level of conceptual design, the main focus shall be the location of traffic signal and not the signal design.

9. Roadway Intelligent Transportation Systems (ITS)

- a. The proposed roadway design shall include provisions for ITS work that can be incorporated into the overall Airport ITS Masterplan. The goal of the Masterplan is to have an infrastructure of ITS subsystems designed to provide detection of and responses to changing conditions, through surveillance and monitoring of traffic operations, traffic management tools and motorist information devices.
- b. At this level of conceptual design, the main focus shall be the location and placement of detection and informational devices on the roadway network that will form the ITS infrastructure. These devices include closed circuit television cameras (CCTV), surveillance cameras, vehicle detectors, and variable message signs (VMS).
- c. All work shall comply with the PANYNJ Intelligent Transportation System Design Guidelines.

10. Future Transit Right of Way

- a. The terminal roadways shall be coordinated with any PANYNJ conceptual layout of a future transit system.

Appendix A – PANYNJ Airport Planning Standards Guidelines for Public Terminal Restrooms

GUIDELINES FOR PUBLIC TERMINAL RESTROOMS

Restrooms play an important role in airport facilities for passenger and staff convenience and passenger perceptions regarding their overall experience at an airport. Passengers and staff should be provided with adequate toilet facilities near all main waiting zones and workplaces.

In an effort to provide the highest level of customer experience, the Port Authority has developed the following planning guidelines to provide airports with public restrooms that balance the needs and expectations of travelers, the efficiency of airport operations, and the costs of building and managing these spaces. These guidelines should be used when renovating, replacing or new construction of restroom facilities.

This document does not supersede the requirements of any applicable code and/or regulation. Any conflicts between the requirements in this document and the applicable codes shall be directed to the Aviation Planning Division for resolution. It is the responsibility of the designer to ensure the conformity of the proposed plans with the most current version of all codes and regulations.

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.

This manual does not provide restroom finishes, materials and color palette guidelines. Future versions of this document may include these parameters.

1. References

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.

The following documents and references provide additional guidelines and best practices for planning and designing terminal restrooms:

- a. ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design
- b. Port Authority Pedestrian Signing and Wayfinding Airport Standards Manual
- c. Americans with Disabilities Act (ADA) Standards for Accessible Design
- d. Others (to be finalized)

2. Restroom Requirements and Locations

- a. Fixtures Needed Calculation – Methodology Guidelines

The toilet fixture counts within each men and women toilet room should be calculated based on the function and occupancy of the terminal area. The table below indicates the bases for determining the requirements for restroom fixtures from the New York City Plumbing Code, the New York State Building and Plumbing Codes and the International Building Code New Jersey Edition.

Planning Criteria Ratios	Units	Restroom Criteria as per Plumbing Codes		
		New York State Plumbing Code	New York City Plumbing Code	International Building Code, New Jersey
Male / Female	Ratio	50%/50%	50%/50%	50%/50%
Fixture: Male	Ratio	1:500	1:500	1:500
Fixture: Female	Ratio	1:500	1:500	1:500
Sinks: Male	Ratio	1:750	1:750	1:750
Sinks: Female	Ratio	1:750	1:750	1:750
Service Sinks: Restroom	Ratio	1:1	1:1	
Maximum Distance to nearest Restrooms	Feet	300	300	

Table A1: Restroom Criteria as per Plumbing Codes

While local building codes should always be consulted, recent industry research shows that building codes only provide minimum requirements. To provide exceptional customer service, code minimums have proven to be inadequate at Port Authority airports.

For this reason, the Port Authority requires the use of the methodology and principles explained in the following pages which were developed based on the latest recommendations from ACRP²²⁰ for the

²²⁰ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

planning and design of public terminal restrooms. The Port Authority’s objective is to provide well-appointed restrooms that provide adequate space for belongings and circulation, ample circulation space, accommodations for individuals with special needs, and highly maintained facilities.

To meet the projected passenger demand requirements, airport restroom sizes must be calculated based on the portion of the terminal they serve: airside concourse, terminal pre-security area, and terminal post-security area. Their number and locations also depend on the planning concept used for concessions: centralized departure concessions versus distributed concessions (within boarding areas/concourses).

For terminals with departure concessions distributed within the boarding area/concourses, restroom requirements should be calculated separately for the two following functional areas:

- Airside concourses (post-security)
- Terminal–landside (pre-security)

Terminal landside restrooms are typically located within the major terminal areas such as check-in, baggage claim, and pre-security concessions areas.

For terminals providing a centralized post-security concession area, additional restroom requirements should be calculated for that particular space:

3. Terminal–centralized departure concession area (post-security)

The following process should be used to determine the minimum number of restroom modules and fixtures needed for each one of the three main functional areas:

- a. Airside concourses calculation

Calculations for restroom requirements on airside concourses must be based on the number of gates available and the design aircraft on each gate.

Step 1: Determine Peak Passenger Capacity

Peak passenger capacity (design passengers) is calculated using the following formula:

$$\begin{aligned} \text{Design Passengers} = & \text{Load Factor} \times (\text{Number of ADG-II gates} \times \text{ADG-II Design Aircraft Seats} \\ & + \text{Number of ADG-III gates} \times \text{ADG-III Design Aircraft Seats} \\ & + \text{Number of ADG-IV gates} \times \text{ADG-IV Design Aircraft Seats} \\ & + \text{Number of ADG-V gates} \times \text{ADG-V Design Aircraft Seats} \\ & + \text{Number of ADG-VI gates} \times \text{ADG-VI Design Aircraft Seats}) \end{aligned}$$

The following minimum planning standards are provided for the load factor and seats per aircraft values for restroom calculation at all Port Authority airports:

Port Authority Minimum Standards	
Load Factor	90%
Seats per Aircraft	
ADG-II (Regional Jets)	76 seats
ADG-III	190 seats
ADG-IV	240 seats
ADG-V	400 seats
ADG-VI	550 seats

Table A2: Port Authority Minimum Standards

Notes:

- A load factor of 90% is given as a minimum at the time this manual was written. However, the Port Authority may require the use of a higher load factor on a per-project basis, based on the specific traffic characteristics of the studied airport and terminal.
- Any proposed adjustment of design aircraft seat values based on the expected fleet mix must be submitted to the Port Authority for review.
- As a standard method, the Port Authority requires the use of design aircraft seats values for the calculation of restroom requirements in airside concourses. This approach will typically produce the conservative case (all gates used). During the planning stage, this value may be compared to the design peak hour (typically resulting from the Design Day Flight Schedule) to gauge effects on total calculated fixtures. Methodologies, based on the peak hour passengers, can be provided to the Port Authority for comparison purposes, in addition to the standard method given by the Port Authority. However, peak hour calculation and simulation methodologies shall not be used to reduce capacity and space requirements calculated through the standard method presented in this manual.

Step 2: Determine Peak 20-minute Passenger Demand

Peak 20-minute passenger demand is calculated using the following formula:

$$\text{Peak 20-Minute Passenger Demand} = \text{Design Passengers} \times \text{Peak 20-Minute Factor (\%)}$$

The Port Authority requires the use of a Peak 20-minute Factor between 50% and 60%, as per the latest recommendations from ACRP²²¹.

²²¹ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

Step 3: Determine Total Number of Men’s and Women’s Fixtures

First, calculate the design factor, which will be used to determine the required fixture count:

$$\text{Design Factor} = \text{Peak 20-Minute Passenger Demand} \times \% \text{ Using Restrooms (utilization)}$$

The Port Authority requires the use of a Utilization Factor of 60%, based on the latest recommendations from ACRP²²² and observations at PANYNJ airports.

As per ACRP Report 130 guidelines, the men’s fixture count is used for base calculations. The men’s recommended fixture count is determined as follows:

$$\text{Men’s Fixtures} = \text{Design Factor} \times \text{Male \%} / 13$$

Note: When the passenger gender mix is unknown, assume a Male% ratio of 50%. The peak 20-minute male passenger ratio (13) is based on an average 1.5-minute male dwell time at a fixture.

The women’s recommended fixture count is determined as follows:

$$\text{Women’s Fixtures} = \text{Male Fixtures} \times \text{Female Increase Factor}$$

Note: The Port Authority requires a Female Increase Factor of 25% or more, based on the latest recommendations from ACRP²²³ and observations at PANYNJ airports.

Step 4 (for international terminals only): Additional Restrooms for Sterile Area

For international terminals, the following restroom requirements must be provided for international arrival passengers deplaning the aircraft and going through the CBP/FIS area:

Federal Inspection Services (FIS):

$$\text{Total Male Fixtures} = \text{Total International Deplaning (arriving) Peak-Hour O\&D Passengers} \times \text{Fixtures Ratio}$$

Note: When the passenger gender mix is unknown, assume a Male% ratio of 50%.

The Port Authority requires the use of the following “Fixtures Ratio”, as per the latest recommendations from ACRP²²⁴: 1 fixture per 70 PHP for first 400 passengers + 1 fixture per 200 PHP in excess of 400 passengers.

$$\text{Total Women Fixtures} = \text{Total Male Fixtures} \times \text{Female Increase Factor}$$

The Port Authority requires a Female Increase Factor of 25% or more, consistent with the latest recommendations from ACRP²²⁵.

In terms of locations, the terminal planner/architect must follow the latest US Customs and Border Protection Technical Design Standards. In particular, restroom facilities shall not be located within the Sterile Corridor System (SCS) and should be as near to the FIS as possible. Restroom locations should be

²²² ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

²²³ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

²²⁴ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

²²⁵ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

provided at both levels of inspection: (1) primary processing/queuing and (2) secondary processing and inspection area.

4. Terminal Landside calculation (pre-security)

Landside restrooms are typically located within the major terminal areas such as check-in, baggage claim, and concessions areas. Calculations are based on the total peak-hour Origin & Destination (O&D) passenger demand (PHP) and the visitors of those passengers.

Visitor ratios are typically provided with airport survey data, compiled by the airport or its planning consultant, and should be used to calculate the total visitor demand when available. However, if this information is unknown, an increase factor of 20 percent for well-wishers (WW) and 30 percent for meeters and greeters (M&G) should be used as a typical industry-wide planning standard²²⁶.

For terminal facilities with enplaning/deplaning passenger processing functions (such as check-in/baggage claim, respectively) on separate levels, utilizing the associated visitor ratios with their respective passenger processing functions is appropriate:

WW + enplaning passengers and, M&G + deplaning passengers

For terminal facilities with check-in, baggage claim and arrival hall/meeters & greeters area functions on a single level, a visitor ratio, comprising the average of the WW and M&G ratios, is more appropriate.

Step 1: Determine Design Passenger Demand

Multi-level Facility:

Check-in:

**Design Demand = Total Enplaning (departing) Peak-Hour O&D Passengers
x WW Ratio (Port Authority Minimum Standard: 1.20)**

Arrivals Hall / Meeters & Greeters Area:

For Domestic Facility (includes the domestic baggage claim):

**Design Demand = Domestic Deplaning (arriving) Peak-Hour O&D Passengers
x M&G Ratio (Port Authority Minimum Standard: 1.30)**

For International Facility:

**Design Demand = International Deplaning (arriving) Peak-Hour O&D
Passengers x M&G Ratio (Port Authority Minimum Standard: 1.30)**

Single-Level Facility (domestic only):

**Design Demand = Total O&D (enplaning/deplaning) Peak-Hour Passengers
x Visitor Ratio (Port Authority Minimum Standard: 1.25)**

²²⁶ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

Step 2: Determine Number of Fixtures

The quantity of fixtures for males is determined through the following formula:

$$\text{Total Male Fixtures} = \text{Design Demand} \times \text{Fixtures Ratio}$$

The Port Authority requires the use of the following “Fixtures Ratio”, as per the latest recommendations from ACRP²²⁷: 1 fixture per 70 PHP for first 400 passengers + 1 fixture per 200 PHP in excess of 400 passengers.

Once the quantity of fixtures for males is determined, use the female increase factor used in the airside calculations.

$$\text{Total Women Fixtures} = \text{Total Male Fixtures} \times \text{Female Increase Factor}$$

Note: The Port Authority requires a Female Increase Factor of 25% or more, as per latest recommendations from ACRP²²⁸.

Fixtures per location per level should then be distributed. As per ACRP guidelines, a fixture count of six per gender is the minimum recommendation to use for any facility type. Restrooms should be located in proximity to the major passenger processing functions such as check-in, baggage claim, security screening, meeter/greeter areas, GTC locations, and major landside concessions nodes. This should be studied carefully as some locations may exhibit lines during peak passenger demand. As a result, a higher percentage distribution for those areas may be required.

Design should consider capacity demands for terminals with integrated multi-modal ground transportation centers (GTCs)—such as taxi, limousine, rail. For such designs, a ground access or curb-front survey would provide valuable passenger modal splits. Enplaning passengers utilizing the GTC, depending on location, should have access to restroom facilities prior to arriving in the check-in hall.

As stated in ACRP Report 130 “Keep in mind that landside and airside restrooms accommodate a different mix of users. While both are visited by travelers and airport employees, landside locations are also frequented by meeters and greeters as well as, in some airports, transportation chauffeurs.” Airport planners should aspire to simultaneously plan to achieve a high level of service and customer satisfaction, while taking into consideration finishes and hardware that can withstand a higher probability of wear and tear from a wide spectrum of non-traveling and traveling patrons.

5. Terminal – centralized departure concession area (post-security)

The development of centralized departure concession areas has become an increasing trend at US airports. For this reason, the Port Authority requires the submittal of a restroom requirements analysis for that particular space, when included in a terminal development (or redevelopment) program.

Due to the variety of parameters involved in the planning of a centralized concession area, the Port Authority requires all developers to provide the following information as part of the restroom requirements analysis for that particular area:

²²⁷ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

²²⁸ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

- O_1 : Maximum Occupancy calculated for the Terminal Airside Concourses
- F_1 : Total Number of Fixtures (men and women) calculated for the Terminal Airside Concourses
- O_2 : Maximum Occupancy calculated for the Centralized Concession Area
- F_2 : Total Number of Fixtures (men and women) calculated for the Centralized Concession Area
- R_{Occ} : O_2 / O_1

The Port Authority requires that a consistent ratio is maintained throughout the entire terminal secure area (post-security) to provide passengers with convenient access to restroom facilities. In order to ensure quality of service, the calculated number of fixtures for the Centralized Concession Areas (F_2) must exceed minimum fixture count of the following formula:

$$F_2 > R_{Occ} \times F_1 - 5\%$$

Designers should consider providing additional restroom facilities for areas with higher passenger dwell times.

6. Planning Considerations for Restroom Location

The guidelines for placement of toilet and support rooms are as follows:

- a. Restroom facilities should be evenly and conveniently distributed throughout the main public areas with a maximum walking distance of 300 feet to a restroom.
- b. Each location (restroom module) should include; men, women, family rooms and a janitor's room for maintenance and clean-up storage. These four (4) rooms should always be grouped together and the respective entry points should be adjacent to each other so that they are visible to the passengers.
- c. Circulation in rooms with larger numbers of fixtures should be laid out in a loop to avoid dead-end conditions.
- d. In airside concourses, restrooms should be conveniently distributed along the passenger circulation corridor.
- e. In the terminal headhouse, restrooms should be located in proximity to and on the same level as major passenger processing functions; such as check-in, baggage claim, security screening, meeter/greeter areas, GTC locations, and major landside concessions nodes.
- f. Restroom locations should be visible from major passenger circulation areas.
- g. Restrooms in high activity areas, such as a concourse or terminal building, should always be available for passengers' use.
- h. Restrooms near bars and restaurants may experience higher utilization and dwell times; and should be considered for designing restrooms in such areas.

The terminal planner/architect should take into account the following recommendations from ACRP in order to determine the optimal restroom locations²²⁹:

- "Historical observations indicate deplaning (arriving) passengers produce the greatest demand for the concourse restroom locations. Because most passengers on short-haul domestic flights will wait to use the restroom facilities until arrival, it is important to provide adequate capacity

²²⁹ ACRP Report 130, Guidebook for Airport Terminal Restroom Planning and Design, 2010

to serve these arriving passengers. This is especially important where near simultaneous flights arriving on adjacent gates will produce a surge effect on the restrooms located nearby.”

- “Observations also indicate that arriving passengers typically use the first restroom location they pass between their arrival gate and baggage claim or a connecting gate. Passenger behaviors suggest this is true even if queues are present and another location may be only a short distance away (passengers are likely uncertain how far away the next restroom is located). Due to these passenger tendencies, a good planning rule, as stated in ACRP Report 25, is to provide fewer restroom locations but with larger capacities. It is also recommended that restroom modules be placed adjacent to major concession nodes within airside concourses.”

For the location of restrooms within the sterile area at International Terminals, the planner/architect must follow the latest US Customs and Border Protection Technical Design Standards. In particular, restroom facilities shall not be located within the Sterile Corridor System (SCS) and should be as near to the FIS as possible. Restroom locations should be provided at both levels of inspection: (1) primary processing/queuing and (2) secondary processing and inspection area.

7. Spatial Components

The following section defines the minimum design intent for the placement and design for toilet facilities within the Terminal Area.

a. Restroom Module

Each restroom module should always include the following elements:

1. Men’s room, with the following components:
 - Sink / lavatories area
 - Coat & Baggage Storage area
 - Toilet stalls (standard, wheelchair-accessible, and ambulatory stalls as per ADA and applicable code requirements)
 - Urinal Area
 - Floor drain(s) in a level floor
2. Women’s room, with the following components:
 - Sink / lavatories area
 - Coat & Baggage Storage area
 - Toilet stalls (standard, wheelchair-accessible, and ambulatory stalls as per ADA and applicable code requirements)
 - Floor drain(s) in a level floor
3. Each restroom module should provide, at a minimum, one family room, signed with the men's and women's handicap symbols. For restrooms with large number of fixtures an additional family room should be provided. (Criteria Pending).
4. Janitor’s room, with easy access to the plumbing chase.

Where possible restroom layout shall provide for the ability for the restrooms to be partially closed for cleaning or maintenance and still maintain public use to 50% of the fixtures.

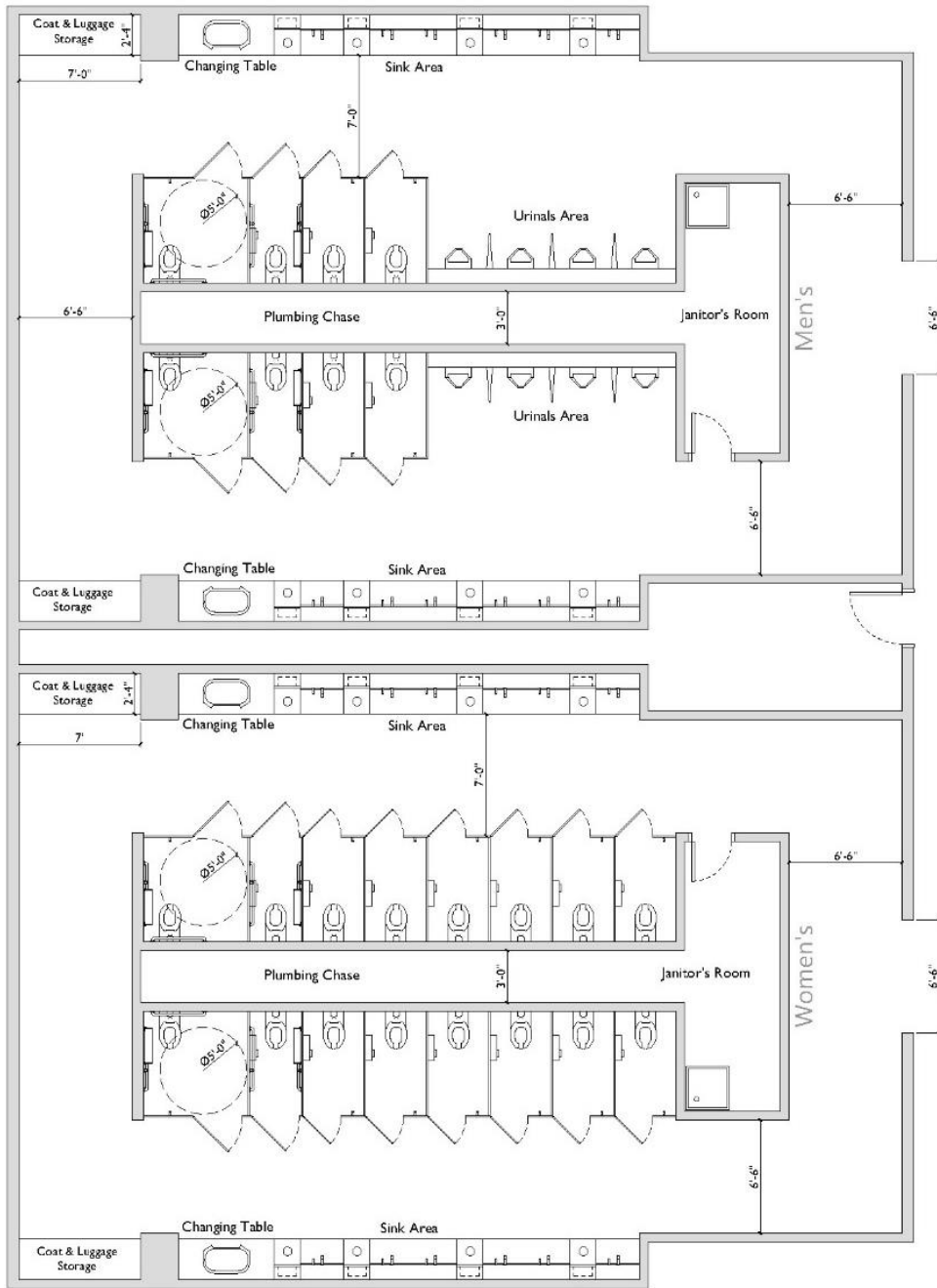


Figure A1: Sample of a Restroom Module

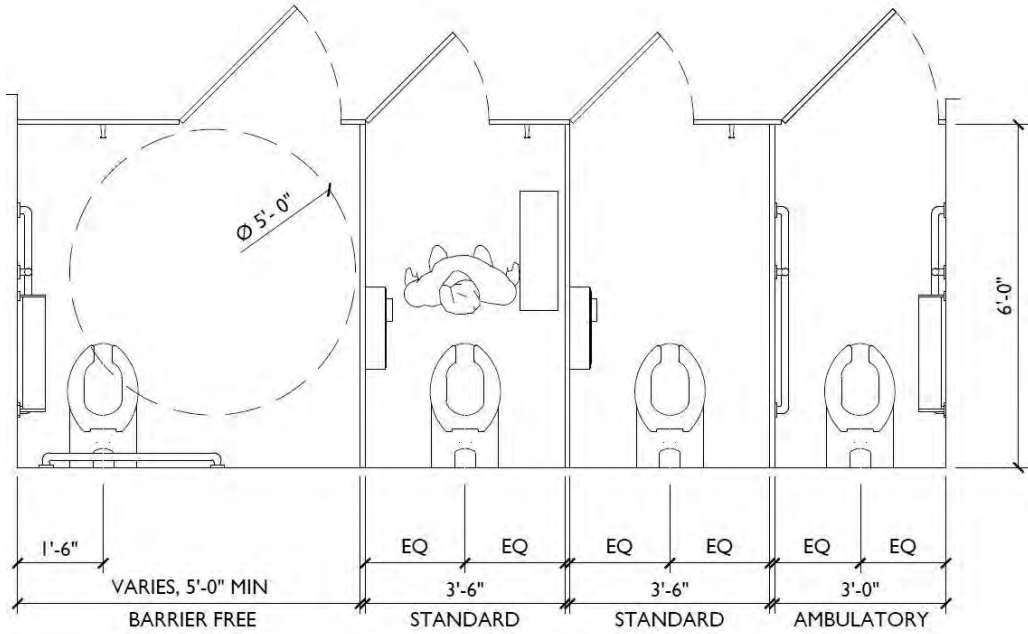


Figure A2: Sample of a Toilet Stalls (standard, wheelchair-accessible, ambulatory)

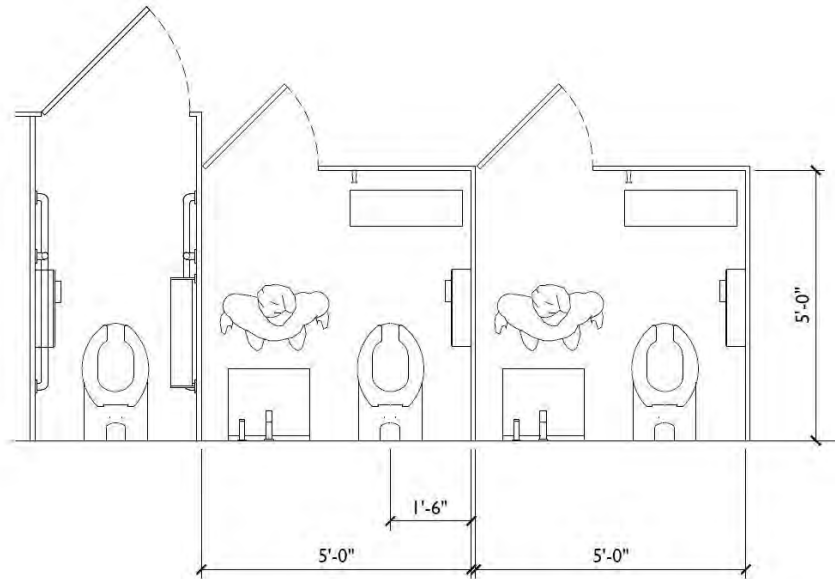


Figure A3: Sample of a "1-stop" Toilet Stall

It is recommended that consultants review the feasibility of 1-stop toilets within the restroom module and implement where possible to enhance customer experience. 1-stop stall layout should utilize standard ceiling mounted stall partitions and include a sink and toilet.

b. Entry Point / Signage

The guidelines for entry points are as follows:

1. The entries into the toilet rooms must be a minimum width of 6'-6" (7' is preferred).
2. All entry points should be designed as open entryways without doors. Size of vestibule width should be increased in relation to size of toilet room.
3. Entries should be designed to prevent line-of-sight from the public areas into the toilet areas.
4. The finishes at eye level in the transition area should reinforce the overhead exterior signage package to confirm a passenger is headed into the correct room. An additional "verification" sign should be installed farther into the entry to confirm the restrooms gender.
5. Restroom identifiers (Men/Ladies/Families) shall be clear and visible and consistent with the Port Authority Pedestrian Signing and Wayfinding Airport Standards Manual.
6. Refer to Port Authority Pedestrian Signing and Wayfinding Airport Standards Manual standards for additional guidelines on signs.
7. Provide dynamic signage to inform passengers of alternate restroom locations and cleaning/maintenance schedules.
8. Provide customer feedback interface or other means to report restroom concerns in real time.
9. Refer to ADA guidelines and Universal Design Guidelines for entry opening standards.



Figure A4: Sample Restroom Entrance

c. Sink Area / Lavatories

The guidelines for toilet room lavatories are as follows:

1. Consider using solid surface material public restroom sinks. All sink surfaces should be self-draining to prevent water ponding.
2. Countertops shall be a solid surface material with matching backsplash on all attached walls. The backsplash shall be a minimum of 6" high. All flat counter top surfaces should be located above or away from sinks to minimize water splashing onto them.



Figure A5: Sample Custom Solid Surface Sink

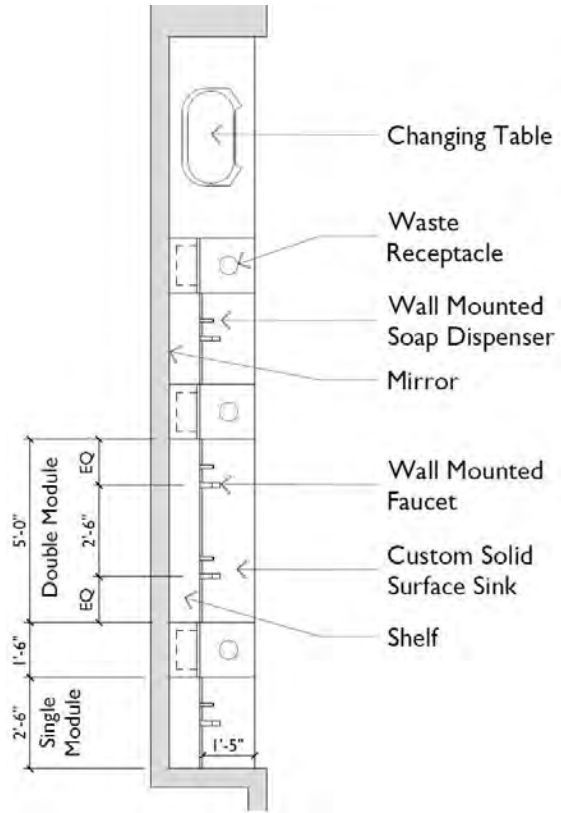


Figure A6: Sink Area / Lavatory Sample Layout

3. Sinks shall be arranged in groupings of two or single lavatory fixtures.
4. Provide a large wall mirror in front of the lavatories between built-out wall pilasters.
5. An 8" diameter trash opening with a 4" (minimum) drop shall be located in the countertop at each pilaster below the surface mounted paper towel dispenser.
6. Trash receptacle (12" minimum wide) shall be in a lockable under counter cabinet.
7. A surface mounted center pull paper towel dispenser should be located on the center pilaster above the trash receptacle opening with clear visibility to meet ADA requirements.
8. Provide water faucet and soap dispenser at each sink
9. Provide a built in 12" deep shelf behind the sink to offers a dry place for belongings.

d. Coat & Baggage Storage Area

The guidelines for the coat & baggage storage area are as follows:

1. Areas should be provided for customers to stow their bags and coats while utilizing restrooms.

2. These areas should be conveniently located, in close proximity to lavatory/sinks area and urinals area (for men's room). Visibility is a necessity and passengers should be able to see their belongings from both the urinals and sink areas.
3. Each area should include the following elements:
 - Passengers should be able to hang their coats/jackets and any other items.
 - Areas for baggage storage should consider ease of storage, cleaning and security.

e. Toilet Stall and Partitions

The guidelines for toilets are as follows:

1. The doors of standard stalls should open out. While out-swinging stall doors may result in being opened onto a passerby, their benefits outweigh this hazard by providing a clear space for individuals to maneuver themselves and their belongings with the door in any position. Having the resting position of stall doors be a position that is a few inches open allows users to readily see if the stall is occupied. Such a practice would eliminate the need for "occupied/vacant" indicators, many of which are problematic because they use the colors red and green, respectively, which prohibits those who are color-blind from deciphering the indicator.
2. Toilets shall be wall hung, white, vitreous china, siphon jet, elongated bowl, with white open-front plastic "contoured" seat without cover. Include proper wall mount chairs/hangers and plumbing chase.
3. Toilets will receive automatic flush controls: they will be mounted on the back wall with the auxiliary flush button no more than 44" AFF.
4. All restrooms shall have sanitary seat covers available.
5. All stall doors must have door locks or latches.
6. All stalls shall be equipped with heavy duty clothes hooks.
7. All stalls shall have built in 10"-12" deep shelf for small bag items.
8. All restrooms shall be equipped with an adequate number of trash receptacles to meet peak traffic flow.
9. Paper products shall be provided in adequate supply to meet peak traffic flow.

The guidelines for toilet partitions are as follows:

1. Partitions shall be ceiling hung with extensions to the floor only as needed for panel stabilization.
2. Partition shall extend from 12" AFF to 78" AFF for privacy.
3. Latches should be easy sliding bars and shall be ADA compliant.
4. Standard toilet stalls shall have a minimum clear dimension of 3'- 6" wide and 6'- 0" deep to provide enough room in front of the toilet to maneuver carry-on luggage.
5. Provide a self-closing door for ADA accessible toilet stalls.

6. Standard toilets shall have water closet centered within the stall. For ADA accessible toilet stalls, centerline of water closet must be between 16" and 18" from the partition.
7. Provide a coat hook on partition side panel, opposite the door swing, to prevent panels and doors from becoming dented. Install hook at a minimum height of 60" AFF to prevent theft of items. Coat hooks must be heavy duty and tamperproof, without face screws.

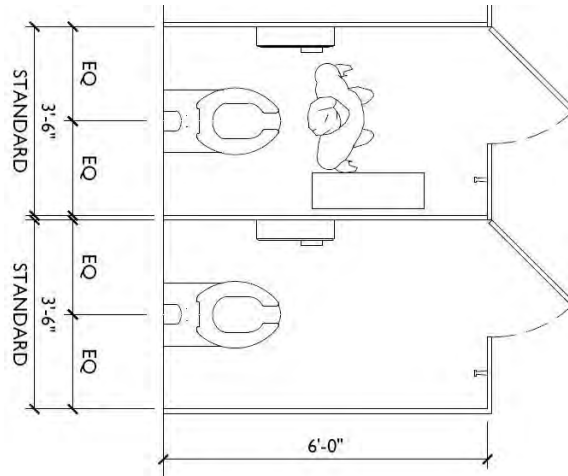


Figure A7: Standard Toilet Stall Layout

f. Ambulatory and Wheelchair-Accessible Stalls

The guidelines for ambulatory toilets are as follows:

1. As per International Building Code requirements, any restroom with six or more toilets / urinals shall be equipped with an ambulatory stall in addition to the required wheelchair-accessible compartment. An ambulatory stall has grab bars on both sides to provide assistance for those with impaired mobility such as the elderly, someone with a broken leg, stroke victims, etc. (see Figure A8).
2. ADA Standards require an ambulatory stall to have a clear width between 35" - 37" and clear length of five feet. Provide an additional foot in length to accommodate carry-on baggage. In addition, this is the same depth as the accessible stall (see Figure A9), which simplifies restroom layouts.
3. The door of the handicapped and ambulatory stalls should open out.

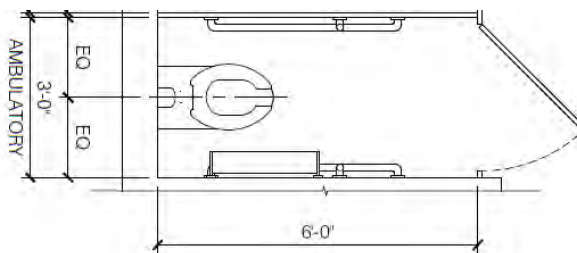


Figure A8: Ambulatory Toilet Stall Layout

The guidelines for Wheelchair-Accessible toilets are as follows:

1. The handicapped accessible stalls and all associate accessories shall be located at end of the row and comply with all applicable codes.
2. Height of accessible toilets and all fixtures shall meet the requirements set forth in the Americans with Disabilities Act (ADA).

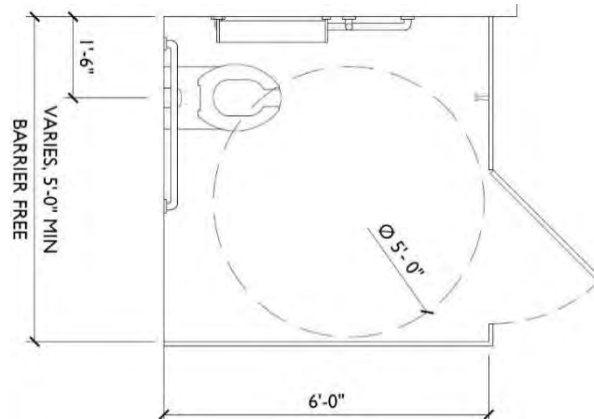


Figure A9: Wheelchair-Accessible Toilet Stall Layout

g. Urinal Area

The guidelines for urinals are as follows:

1. Urinals shall be white, vitreous china, wash out type, wall hung with a large tapered elongated bowl rim.
2. Urinals shall be mounted minimum of 3'-6" on center to provide adequate room with 24" privacy partitions installed between each urinal
3. Flush controls shall be automatic; they will be mounted on the back wall with the auxiliary flush button no more than 44" AFF.
4. Provide a 10"- 12" deep built-in small bag shelf in the vicinity of the urinal mounting surface. ADA urinal will have lower shelf and lower flush assembly.

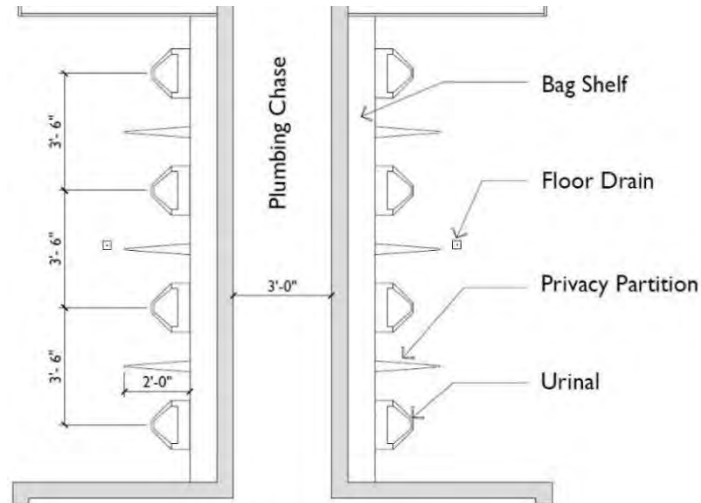


Figure A10: Urinal Area

h. Family Rooms

The Family Rooms should always contain the following:

1. One (1) lavatory counter
2. One (1) handicapped toilet
3. One (1) diaper changing station
4. Each door shall be equipped with kick plates and door hardware and equipped with a corridor lock function (locked from the inside only). Considerations should be given for controlled access to best service our customers.
5. Floor drain in a level floor

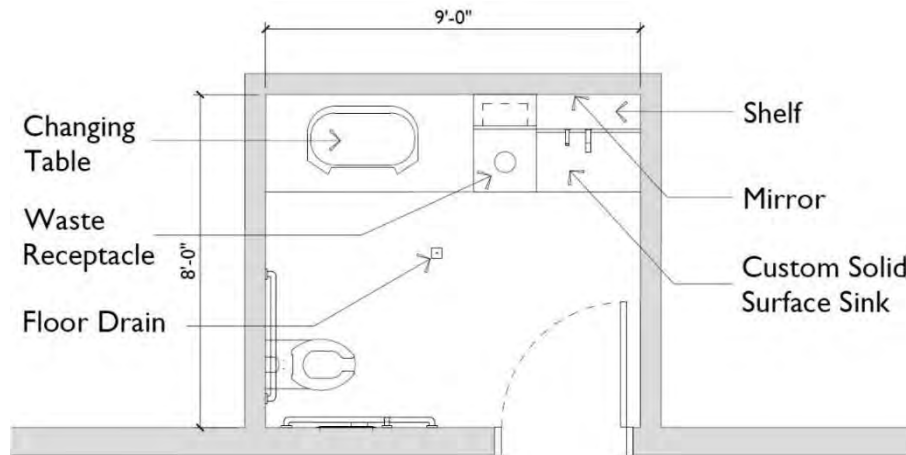


Figure a11: Family Room Layout

i. Janitor's Room

Provide a janitor's room adjacent to multi-stall toilet rooms. The room shall include the following minimum amenities: (See Figure A12)

1. Mop/Slop sink.
2. Hose bib over a floor mounted mop sink with protective surfaces around mop sink as required by code.
3. Mop hangers.
4. Storage shelving (for cleaning, maintenance, customer use supplies and operations)
5. Floor drain.
6. Access door to plumbing chase.
7. The entrance door shall be equipped with kick plates on the push side of the door.

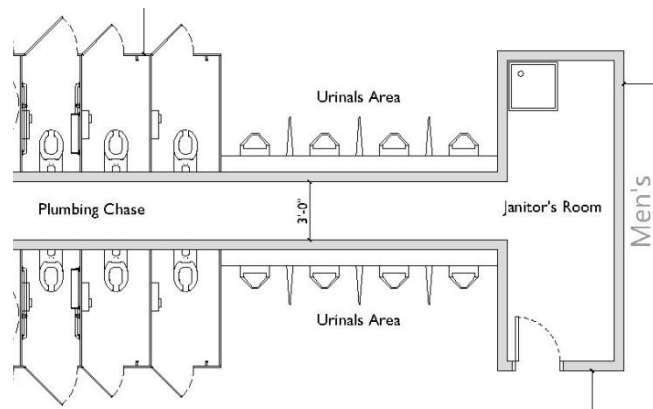


Figure A12: Janitor's Room Layout

j. Plumbing Chase

1. Finishes / fixtures must ensure easy cleaning process
2. Service chases shall be provided behind all fixture walls and be a minimum of 3'-0" clear from the inside face of the metal framing. This will provide ease of maintenance and minimize restroom closures for service.
3. 2'-0" wide (minimum) lockable service door shall be provided at each chase.
4. Floor drains and hose bibs are required in all chase areas.
5. Pipe elevations should be designed and organized to all fit into the chase. Ideally the waste piping should slope toward the chase door and a cleanout should be provided above the spill line to allow for easy access and the ability to clean out that piping as needed. Enough space should be provided at the chase entry to allow the door to close when someone is working at that end. This conceals maintenance personnel from public view."

8. Restroom Accessories

Each Restroom shall receive the required toilet accessories to serve the needs of a public toilet. This section will determine the quantities and locations of specific accessories.

The guidelines for toilet room accessories are as follows:

- a. A restroom stall shall include the following minimum partition mounted toilet accessories:
 1. One (1) stainless steel jumbo toilet tissue dispenser with capacity to hold two (2) toilet tissue rolls. (each side for partition type dispensers)
 2. One (1) toilet seat protector dispenser
 3. One (1) feminine product receptacle. (Women's only.)
- b. All toilet accessories are to be commercial grade and vandal resistant.
- c. All similar type of restroom accessories should be selected from the same manufacturer to keep continuity and uniform appearance.
- d. Grab bars are to be 1-1/2" diameter stainless steel, 18 gauge, Type 304, brushed satin finish with peened gripping surface.
- e. Grab bars are to be mounted using concealed plates, without exposed fasteners; concealed anchors are to be used for each specific wall type.
- f. Soap dispensers should be provided adjacent to each sink.
- g. Soap dispensing system should consider bulk dispensing systems to minimize service maintenance.
- h. A recessed 12-gallon waste receptacle shall be mounted at each door location.
- i. Each toilet room shall include a minimum of one (1) baby changing station.
- j. Provide a full-height dressing mirror out of the main circulation path.

9. Guidelines for Improved Passenger Experience

- a. General Requirements
 1. Considerations in terms of lighting:
 - Indirect lighting
 - Natural lights
 - Overall experience

The following sections address different locations for task lighting.

2. Entry

Lighting at the entries should accent signage that designates wayfinding. Lighting levels should not be too bright (or dim) such that users have a hard time transitioning visually from the adjacent area into or out of the restroom.

3. Sink Area

Lighting at the sink should be oriented to provide even vertical illumination (from the sides) onto the face, but somewhat softly to avoid glare into the eyes. Lighting from above the mirror can supplement the vertical lighting but should not be the sole source as it casts shadows that make a person's face look

tired and gaunt. Vertical lighting should be evenly balanced on both sides of the face. Lighting integrated within mirrors works well to keep the walls clear of clutter and surfaces that collect dust.

4. Toilet Stalls

Lighting at the utility wall or over the toilet stalls will offer a clean and crisp appearance. Consider providing indirect lighting.

b. HVAC

To improve quality of space by elimination odor and increasing air quality. Consider engineered ventilation systems that minimize recirculation of air, introduce fresh air in to the space, increase air changes per hour as well as applications of odor eliminating systems.

c. Entry points / Signage

Using an iconic façade and entry on restrooms throughout the airport would help travelers to recognize and supplement identifying signs. Designer should consider bold colors, text, or graphics to help identify gender.

d. Other design items to be considered:

- Floor Surfaces
- Wall Surfaces
- Ceiling Surfaces
- Lighting / Electrical
- Corner Guards and Edge Protection Profiles

e. Artistic Design / Environmental Graphics Feature

The Artistic Design / Environmental Graphics Feature criteria supports the PANYNJ's program to maintain and upgrade, as required, public restrooms within the PANYNJ's stewardship to a "World Class Level of Service" consistent with industry best practices and in order to enhance our customer's experience, with immediate effect, all current, future restroom renovations, and new construction must include at least one artistic design feature including, but not limited to texture, color, material, and other possibilities that enhance the physical and psychological qualities of the space and offer customers a memorable experience.

All proposals are subject to a review and approval process, by committee, managed by the Port Authority. The following sixteen Evaluation Criteria are the minimum level of performance for any submission. The Port Authority is open to recommendations that set a new premise for creative expression, innovation, and technical breakthroughs, while meeting or exceeding all criteria and safety considerations. Any submission that does not conform to these minimum criteria will not be considered nor approved.

Please note: It is the Port Authority's intention that in the next iteration of the Tenant Construction and Alteration Process (TCAP) Manual, this process will be removed from the Airport Planning Standards and be covered in the TCAP Manual.

f. Evaluation Criteria

	Evaluation Criteria	Evaluation Criteria Detail
A.	<i>Objectives</i>	
1.	Enhance the physical and psychological qualities of the space and offer customer a memorable experience.	
2.	Theme based to allow individual installations to work collectively and add a sense of space.	
3.	Attractive and inspiring design that engages travelers.	
B.	<i>Location</i>	
4.	Strategically located to be highly visible	How well does the feature location promote exposure to maximum numbers of traveling public.
5.	Contribute to passenger orientation and intuitive way finding.	Does the feature assist with passenger orientation or does it detract from intuitive wayfinding.
C.	<i>Design and Color</i>	
6.	Design to evoke positive passenger experience.	Does the feature provoke a unique, original, positive, and memorable experience.
7.	Incorporate regional character and culture.	Are regional character and cultural elements prominently featured in the design.
8.	Use of colors, patterns, textures and imagery to providing uplifting and cheerful space.	How well do the selected colors, materials, textures, and imagery contribute to improve ambiance.
9.	Design and color schemes to be considerate of locations within terminal.	Does the design and color scheme respond to different installation locations within terminal, i.e., pre-security vs. post security and arriving vs. departing areas.
10.	Feature to work in concert with lighting sources and levels. Incorporate day light where possible.	Does the installation take advantage of natural day light opportunities? Do the proposed lighting fixtures, lighting levels, and light sources complement features location, colors, materials, and textures.

	Evaluation Criteria	Evaluation Criteria Detail
D.	<i>Materials and Installation</i>	
11.	Materials and installation shall be durable and easy to clean.	Are the materials and finishes durable and easy to clean? How well are the selected materials expected to stand up to high volume of passenger traffic. Do the proposed finishes and materials require special cleaning agents or procedures.
12.	Compatibility of materials and finishes to promote unified design.	How well are the selected materials and finishes work together to enhance the design concept and promote a unified appearance. For installation at existing facilities, with minimal changes, how well do the proposed material and finishes work with existing finishes.
13.	Modern timeless design using warm, inviting and light-colored finishes	Will the design be fresh and relevant over the expected life span of the feature? How well do the proposed materials contribute toward creating an inviting, pleasing, and well-lit space.
14.	Minimize ecological impact by incorporating environmentally friendly and sustainable practices	Are the selected materials and installation procedures environmentally friendly and in line with sustainable practices.
E.	<i>Ease of Installation</i>	
15.	Installation duration	What is the installation duration of proposed feature? Can it be installed off hours without taking the restroom out of service. Is the concept compatible with phased installation to help minimize restroom down time.
16.	Standard installation procedures	Can the feature be installed by a general contractor? Does the installation require any nonstandard tools or procedures.

Table A3: Evaluation Criteria for Restroom Artistic Design / Environmental Graphics Feature

g. Submittal Requirements

Refer to Port Authority of New York and New Jersey Tenant Construction and Alteration Process (TCAP) for complete list of required documents. Submissions shall include, but not be limited to:

PANYNJ TAA Documents	PANYNJ TAA Submittal Documents and a letter of intent articulating scope of work, anticipated budget, and anticipated duration. Certifications of all specialized trades. Asbestos report where required.
Architectural drawings	Site Plan, Summary of Applicable Codes and ADA / Universal Design integration, Demolition Plans with proposed barrier locations, Floor Plans, Reflected Ceiling Plans, Section, Elevations, Finish Plans and Schedules, MEP Drawings as required. (Phasing plans where applicable)
Specification	Technical specifications for all materials and installation methods
Architectural Renderings and illustrations	Rendering with multiple views to clearly describe the design concept
Finish Boards and material samples	Finish boards, samples and manufacturers literature of all major finishes. Samples to be clearly coded and coordinated with plans and rendering.

Table A4: Submittal Requirements for Restrooms Artistic Design / Environmental Graphics Feature

Appendix B – List of Acronyms and Abbreviations

A4A: Airlines For America
AASHTO: American Association of State Highway and Transportation Officials
AC: Advisory Circular
ACRP: Airport Cooperative Research Program
ADA: Americans with Disabilities Act
ADG: Aircraft Design Group
ADPM: Average Day of the Peak Month
ADRM: Airport Development Reference Manual
AIT: Advanced Imaging Technology
AL: Alarm Line
ANSI: American National Standards Institute
APHIS: Animal and Plant Health Inspection Service
APM: Automated People Mover
ASL: Automated Screening Lanes
AT: Advanced Technology
ATCT: Airport Traffic Control Tower
ATO: Airline Ticket Office
ATR: Automated Tag Readers
AVS: Alternate Viewing Station
AVS: Alternate Viewing Station
AWDPM: Average Weekday of the Peak Month
BHS: Baggage Handling System
BIM: Building Information Management
BIT: Baggage Inspection Table
BLS: Bottle Liquid Scanner
BSO: Baggage service office
CAD: Computer Aided Design
CAGR: Compound Annual Growth Rates
CBIS: Checked Baggage Inspection System
(US)CBP: (United States) Customs and Border Protection
CBRA: Checked Baggage Resolution Area
CDG: Checkpoint Design Guide
CL: Clear Line
CTA: Central Terminal Area
DDFS: Design Day Flight Schedules
DHS: Department of Homeland Security
EBS: Early Bag Storage
EDS: Explosives Detection System
EQA: Equivalent Aircraft
ETD: Explosives Trace Detection
FAA: Federal Aviation Administration
FEMA: Federal Emergency Management Agency
FIS: Federal Inspection Services
GSE: Ground Service Equipment
HOV: High Occupancy Vehicle
Port Authority of NY & NJ
Airport Planning Standards – APPENDIX B -PRELIMINARY DRAFT

HSC: High Speed Conveyor
HVAC: Heating, Ventilation, and Air Conditioning
IATA: International Air Transport Association
ICAO: International Civil Aviation Organization
ICC: International Code Council
ICS: Individual Carrier System
ITS: Intelligent Transportation Systems
KCM: Known Crewmember
LAN: Local Area Network
LEO: Law Enforcement Officer
LOS: Level of Service
MAAP: Million Annual Air Passengers
MARS: Multi-Aircraft Ramp System
MDR: Manual Diverter Roller
MEP: Mechanical, Electrical, Plumbing
MUP: Make-Up Positions
MUTCD: Manual on Uniform Traffic Control Devices
NFPA: National Fire Protection Association
NYCDOT: New York City Department of Transportation
NYPD: New York Police Department
O&D: Origin and Destination
O&M: Operations and Maintenance
OOG: Out-of-gauge
OOS: Out of Spec
OS: Oversize
OSR: On Screen Resolution
PA: Port Authority
PA: Public Address
PANYNJ: Port Authority of New York and New Jersey
PBB: Passenger Boarding Bridges
PCA: Preconditioned Air
PFSP: Potential Fuel Spill Point
PGDS: Planning Guidelines and Design Standards
PRM: Passengers with Reduced Mobility
PSR: Private Screening Room
PWC: Potable Water Cabinets
QAD: Quality Assurance Division
RBS: Risk-based Security
RFID: Radio Frequency Identification
RIDS: Ramp Information Display System
RL: Re-insert Line
RSR: Restricted Service Road
SIDA: Secure Identification Display Area
SOP: Standard Operating Procedure
SSCP: Passenger Security Screening Checkpoints
TAA: Tenant Alteration Application
TAF: FAA Terminal Area Forecasts

TDC: Travel Document Check
TNC: Transportation Network Companies
TOS: Tail of Stand
TRB: Transportation Research Board
TSA: Transportation Security Administration
TSD: Technology Services Department
TSO: Transportation Security Officers
UEC: Universal Encoding Console
ULD: Unit Load Device
UPS: Uninterruptible Power Supply
USDA: US Department of Agriculture
UV: Ultraviolet
VDGS: Visual Docking Guidance Systems
VIP: Very Important Person
VSU: Vertical Sortation Units
WAN: Wide Area Network
WTMD: Walk-through Metal Detector