TRANSPORTATION RESEARCH BOARD

TRB

ACRP

Airport Cooperative Research Program




Airport Terminal Planning and Innovative Facilities

Bruce Anderson

Joel Hirsh

Matt Lee

Phil Mein

Monday, April 26, 2010

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

National Academy of Sciences
National Academy of Engineering
Institute of Medicine
National Research Council

Passenger Terminal EXPO 2010

THE NATIONAL ACADEMIES

ACRP Current Status

176 research projects authorized

- 47 starting up
- 50 research in progress
- 15 research completed
    - 64 ACRP publications

Over 700 industry volunteers participating

- Participants come from airports; airlines; consultants; academics; state and federal government; and industry associations

Dozens of research contractors also from the airport industry

Airport Cooperative Research Program

4 ways to become involved:

- Submit a research idea, also called a Problem Statement.
- Volunteer to participate on a project panel. (We reimburse for travel.)
- Prepare a proposal to conduct research.
- Use our research results.

www.TRB.org/ACRP

For More Information : www.TRB.org/ACRP

- Information on ACRP (look for our brochures)
- Search engine
- All research projects
- Project statements (requests for proposals)
- Anticipated projects
- CRP publication lists (how to order)
- Registration form for receipt of RFPs
- Forum for success stories

The Transportation Research Board (TRB) Airport Cooperative Research Program (ACRP) combined two research projects,

ACRP 07-04
Terminal Planning Spreadsheet Models

and

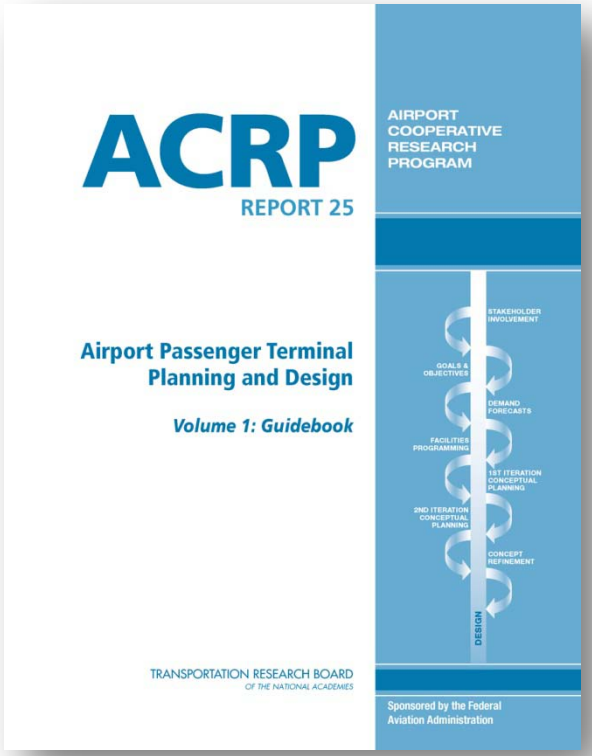
ACRP 07-05
Airport Passenger Terminal Planning Guidebook

into,

ACRP REPORT 25
Volume 1: Guidebook
Volume 2: Spreadsheet Models

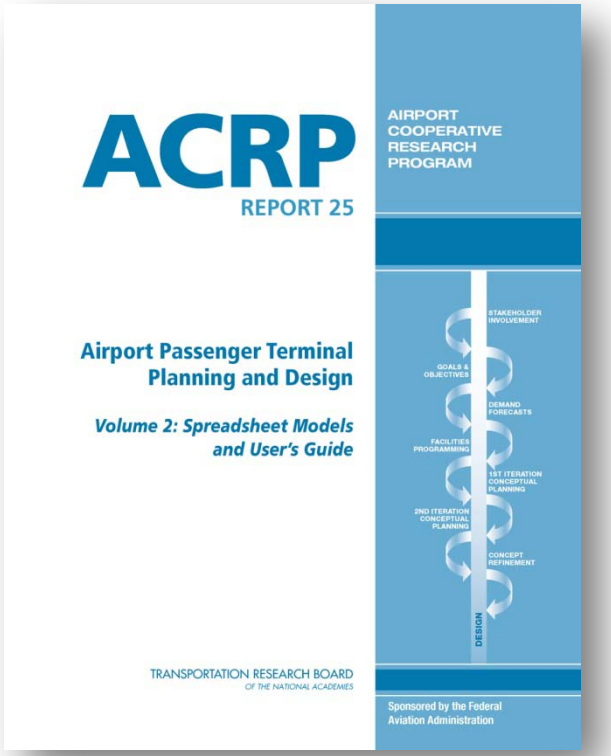
Report 25: Airport Passenger Terminal Planning Volume 1: Guidebook

- ACRP Project 07-05
- Research Agency:
  - Landrum & Brown
- Principal Investigator:
  - Bruce Anderson
- Subcontractors:
  - Hirsh Associates
  - Kimley-Horn and Associates
  - Jacobs Consultancy
  - The Strategic Airport -Planning Group
  - TranSecure, Inc.
  - Steven Winter Associates, Inc.
  - Five Star Systems (G&T Conveyor)
  - Presentation & Design, Inc.



Report 25: Airport Passenger Terminal Planning Volume 2: Spreadsheet Model

- ACRP Project 07-04
- Research Agency:
  - Landrum & Brown
- Principal Investigator:
  - Matt Lee
- Subcontractors:
  - Hirsh Associates
  - Planning Technology, Inc.
  - Presentations & Design, Inc.



A07-05 Project Panel

Chair:

Dr. Robin R. Sobotta
Department of Business,
Embry-Riddle Aeronautical University

Members:

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Senior Engineer
Applied Research Associates

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Walter P. Moore and Associates

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Rudolph R. Mueller, III
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Transportation Research Board

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Transportation Research Board

Report 10: Innovations for Airport Terminal Facilities

- ACRP Project 07-01
- Research Agency:
  - Corgan Associates
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- Subcontractors:
  - Ricondo & Associates
  - TransSolutions, LLC
  - TranSecure LLC

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Prianka N. Seneviratne, P.E.
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Asian Development Bank

Lawrence Smith, P.E.
Consultant

ACRP Project Manager:

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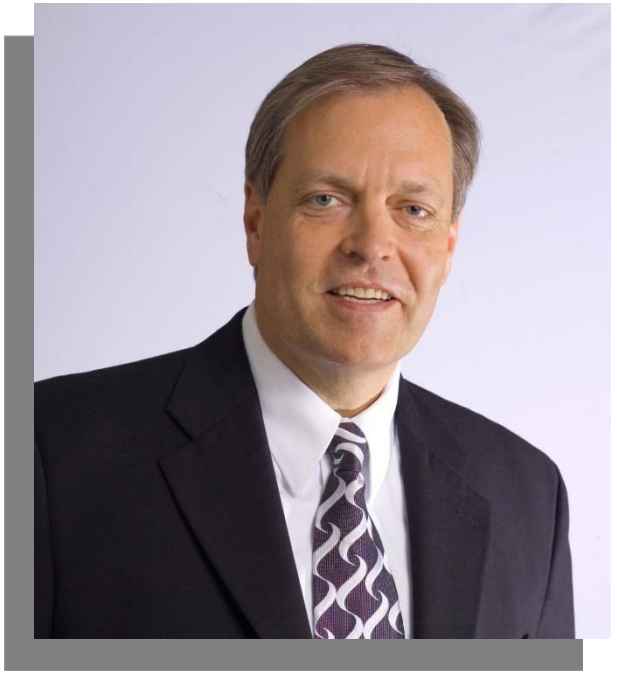
Allen Hoffman
Co-Investigator
Ricondo & Associates, Inc.

Art Cosatka
Co-Investigator
TransSolutions, LLC

Jacob Strawn
Co-Investigator
Ricondo & Associates, Inc.



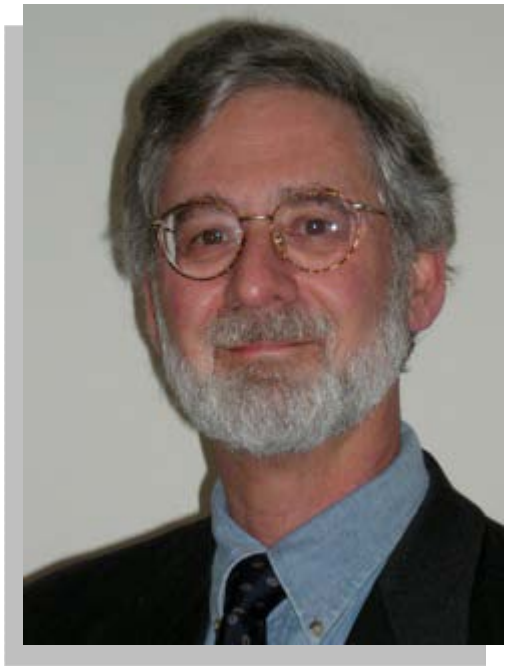
Bruce Anderson
Landrum & Brown

ACRP REPORT 25

Airport Passenger Terminal Planning and Design

Volume 1: Guidebook

Joel Hirsh
Hirsh Associates



ACRP REPORT 25

Airport Passenger Terminal Planning and Design

Volume 1: Guidebook

ACRP 07-04 Objectives

- To develop a user-friendly spreadsheet model (or models), with an accompanying manual to analyze issues common to airport passenger terminal planning and design.

- To produce a compendium that identifies the types, scopes and availability of spreadsheet and discrete event models that can be used by airport operators for airport passenger terminal planning and design.

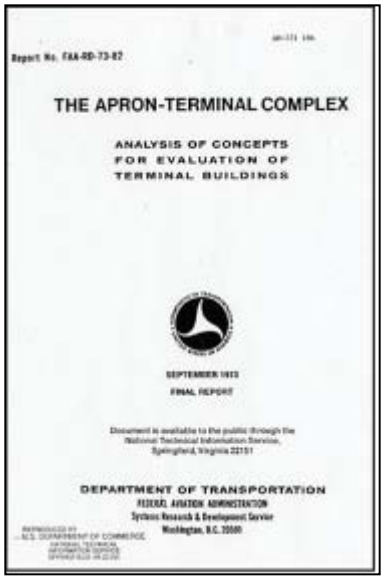
ACRP 07-05 Objectives

- To produce an Airport Passenger Terminal Planning Guidebook that:
  - Provides a comprehensive and up-to-date approach to the terminal planning process.
  - Addresses current issues and emerging trends
  - Will be useful for airport managers, consultants, industry organizations and other stakeholders of commercial aviation market.
- The Guidebook will now include the results of ACRP 07-04 Spreadsheet Models for Planning and Design and will be published as ACRP Report 25

Relevance to the Aviation Industry

- Aimed at the general airport planning and design industry
  - Guidebook is broad in scope with basic level of detail supplemented by detailed treatise on selected topics, for example, the development of facility requirements.
  - Guidebook attempts to bring into one location the various sources of information needed to plan a terminal, in particular, FAA AC references with typical information on how to get updates through the web.
  - The Guidebook is more of a “how to” approach based on the latest accepted practices as compared to research. Our approach was to provide “guidelines” as a point of departure from which various practicionaries can then impart their creativity.

Terminal Planning Historical Documents



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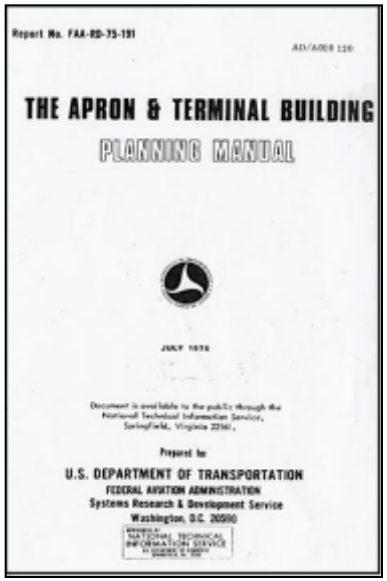


1975

2004

2010

ACRP 07-04 Research Team

- ACRP Senior Program Officer – ***Theresia Schatz***
- O-I-C and Project Manager – ***Bruce Anderson (Landrum & Brown)***
- Principal Investigator – ***Matthew H. Lee (Landrum & Brown)***
- Co-Investigator – ***Joel Hirsh (Hirsh Associates)***
- Co-Investigator – ***Robert Ori (PTI)***
- Senior Investigator – ***John Ernst (Landrum & Brown)***
- Deputy Project Manager – ***Shane Wirth (Landrum & Brown)***
- Research Consultant – ***David Burns (Landrum & Brown)***

ACRP 07-05 Key Research Team Members

- ACRP Senior Program Officer – ***Theresia Schatz***
- Principal Investigator – ***Bruce Anderson (Landrum & Brown)***
- Co-Investigator – ***Joel Hirsh (Hirsh Associates)***
- Terminal Research Advisor – ***Edward (Gary) Blankenship (Landrum & Brown)***
- Landside Research Advisor – ***Foster de la Houssaye (Kimley-Horn Associates)***
- Airside Research Advisor – ***Russell Blanck (Landrum & Brown)***
- Research Consultant – ***Shane Wirth (Landrum & Brown)***
- Advisor – Terminal business and Financial Analysis – ***Spencer Ballard (JACOBS)***
- Advisor – Concessions Revenue Maximization – ***Bill Matz (The S-A-P Group)***
- Advisor – Sustainability – ***Andrew Hathaway (Steven Winter Associates)***
- Advisor – Terminal Security – ***Art Kosatka (TranSecure)***
- Advisor – Information Technology Systems – ***James McGuire (TranSecure)***
- Advisor – Baggage Handling Systems – ***Dan Stricklin (Five Star Systems)***

Resource Base – FAA "White Papers"

- Initial discussions for a new Guide to Terminal Planning began with a call for 'White Papers' in 2001.
- Industry professionals and leaders began making conceptual contributions.
- While the FAA owns the rights for the use of these materials, the Research Team considered it important to notify authors of the potential use of their white papers in the coming Guidebook release.
- 43 FAA unpublished topic papers produced by 42 industry experts on the subject of airport passenger terminal.

Resource Base – FAA "White Papers"

- Gloria G. Bender
- Peter Bianconi
- Edward (Gary) Blankenship
- Thomas H. Brown
- Greg Casto
- David A. Daileda
- Richard de Neufville
- Paul Dorsey
- Daniel J. Feil
- Andrew Grenier
- Steve Rondinelli
- Joel B. Hirsh
- Robert Hornblower
- Michael O'Brien
- Robert Jones
- Art Kosatka
- David Lind
- Peter B. Mandle
- Douglas M. Mansel
- Ted McCagg
- Francis X. McKelvey
- Phil Mein
- Ralph Bauer
- Eric E. Miller
- Mark W. Nagle
- Michael O'Brien
- Colleen E. Quinn
- Frederick R. Busch
- James M. Robinson
- Derrick Choi
- LaVern D. Rollet
- Joseph F. Romano
- Fred Silverman
- Ron Steinert
- Marilyn Taylor
- Keith Thompson
- Tony Vacchione
- Regine Weston
- Norman D. Witteveen
- Harry P. Wolfe

Guidebook Table of Contents

Guidebook Table of Contents

Guidebook Table of Contents

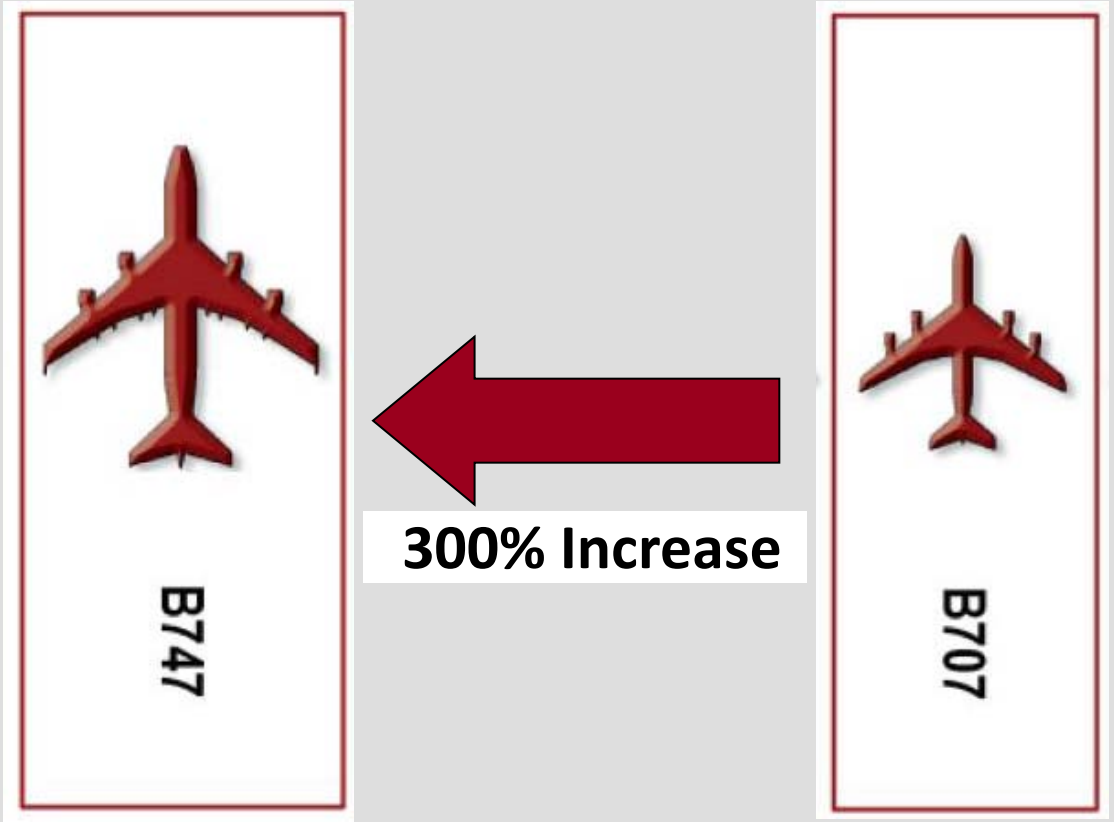
Guidebook Table of Contents

Guidebook Table of Contents

Chapter Highlight

CHAPTER 1: INTRODUTION

1. **Purpose and Organization of th Guidebook**
2. **Previous Termina Planning Guides**
3. **Current need for Terminal Planning Guidance**
4. **Retrospective**
5. **Airline Deregulation**



Chapter Highlights

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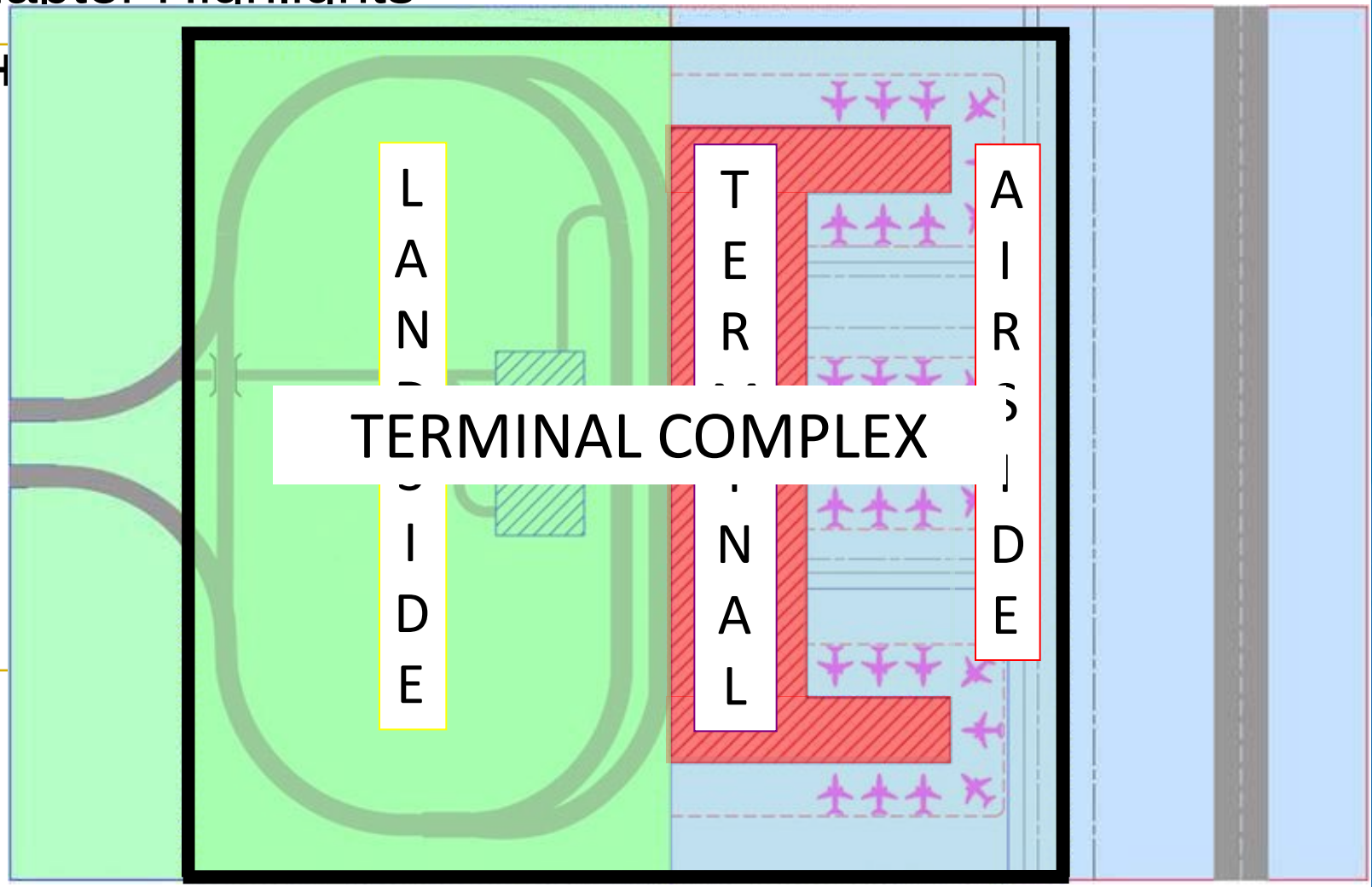
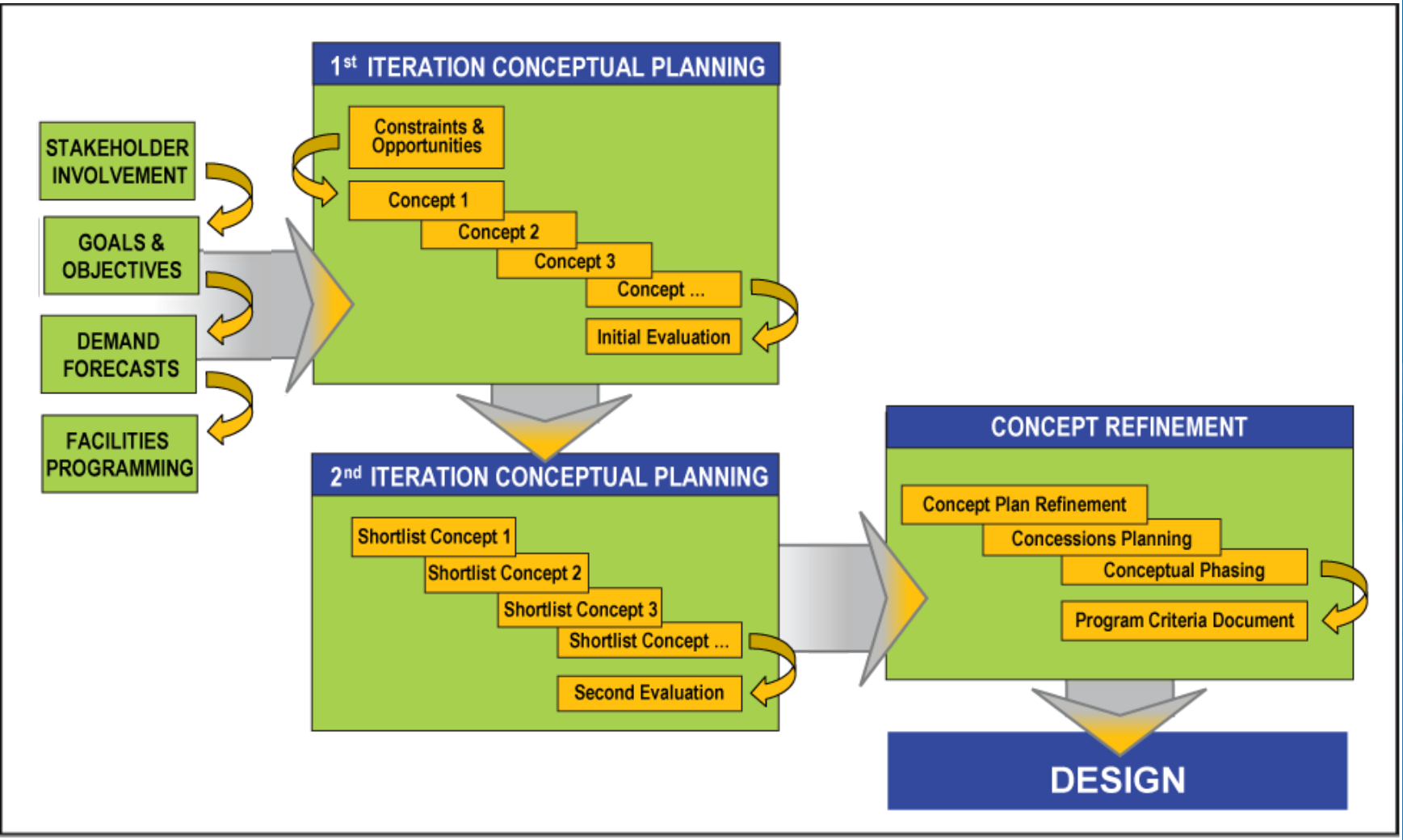
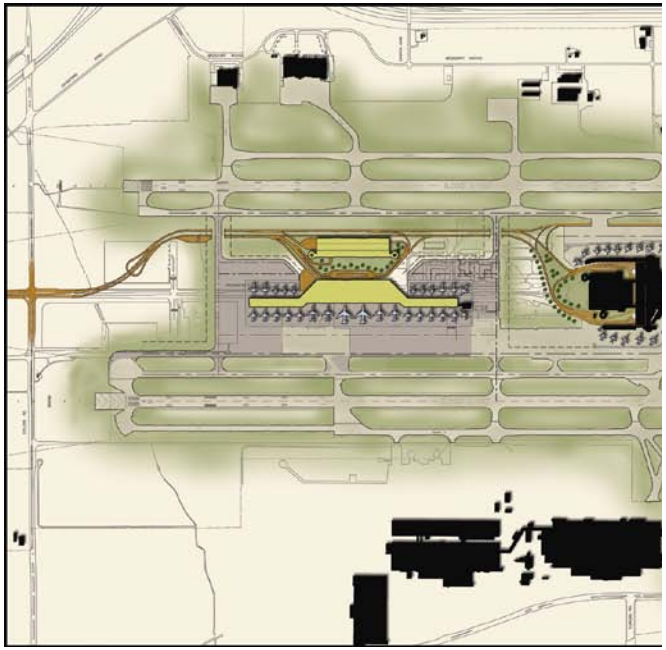



STAKEHOLDER INVOLVEMENT
GOALS & OBJECTIVES
DEMAND FORECASTS
FACILITIES PROGRAMMING
1st ITERATION CONCEPTUAL PLANNING
Constraints & Opportunities
Concept 1
Concept 2
Concept 3
Concept ...
Initial Evaluation
2nd ITERATION CONCEPTUAL PLANNING
Shortlist Concept 1
Shortlist Concept 2
Shortlist Concept 3
Shortlist Concept ...
Second Evaluation
CONCEPT REFINEMENT
Concept Plan Refinement
Concessions Planning
Conceptual Phasing
Program Criteria Document
DESIGN

Chapter Highlights

CHAPTER 2: THE TERMINAL PLANNING AND DESIGN PROCESS

1. **Defining the Terminal Complex**
2. **Terminal Planning and Design Projects**
3. **Terminal Planning and Design Project Approach**



Chapter Highlights

CHAPTER 3: PLANNING CONSIDERATIONS

1. **Airport Master Plan**
2. **Land Use Compatibility**
3. **Ground Access Transportation**
4. **Terminal Site Planning**
5. **Airport Security**
6. **Information Technology and Communications**
7. **Environmental**
8. **Sustainability**
9. **Business Planning**

The integration of a new passenger terminal with a major multi-modal ground transportation center and associated commercial and residential developments at the Shanghai Hongqiao Airport is another example.
Figure III-1 is from *Graphic Illustration of Hongqiao Integrated Transportation Hub*.

Chapter Highlights

CHAPTER 4: FORECASTS

1. **Methodologies**
2. **Data Sources**
3. **Typically Forecasted Information**
4. **Peak Hour Demand Analysis**

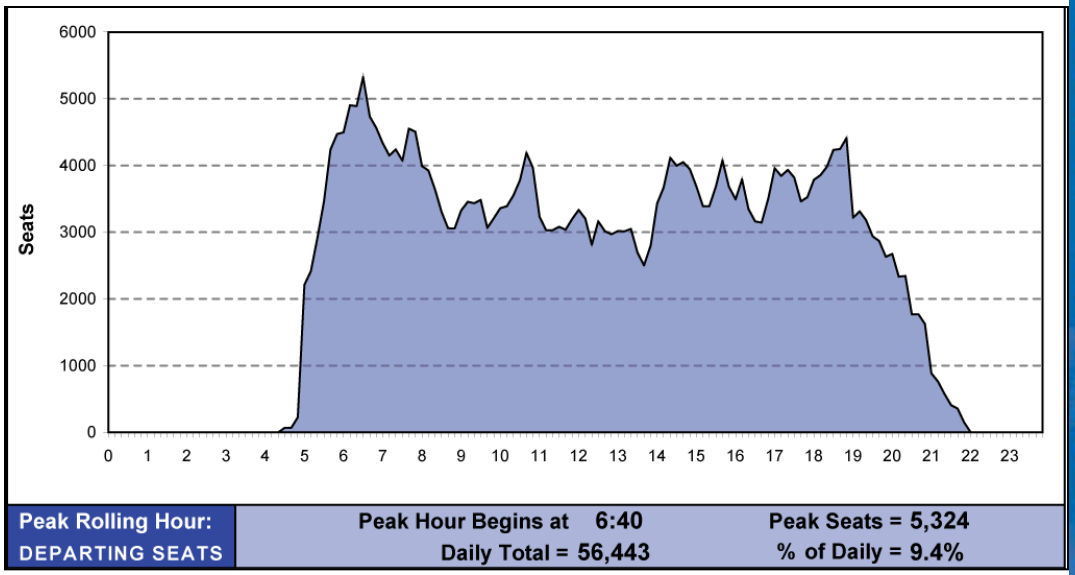


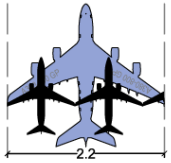
Figure IV-1 is a chart that is created in the Peak Hour Determination model which is part of the companion set of models developed to work with the material in the guidebook.

Chapter Highlights

CHAPTER 5: TERMINAL AIRSIDE FACILITIES

1. **Airside Planning Requirements**
2. **Terminal Apron Planning**
3. **Aircraft Gate Requirements**

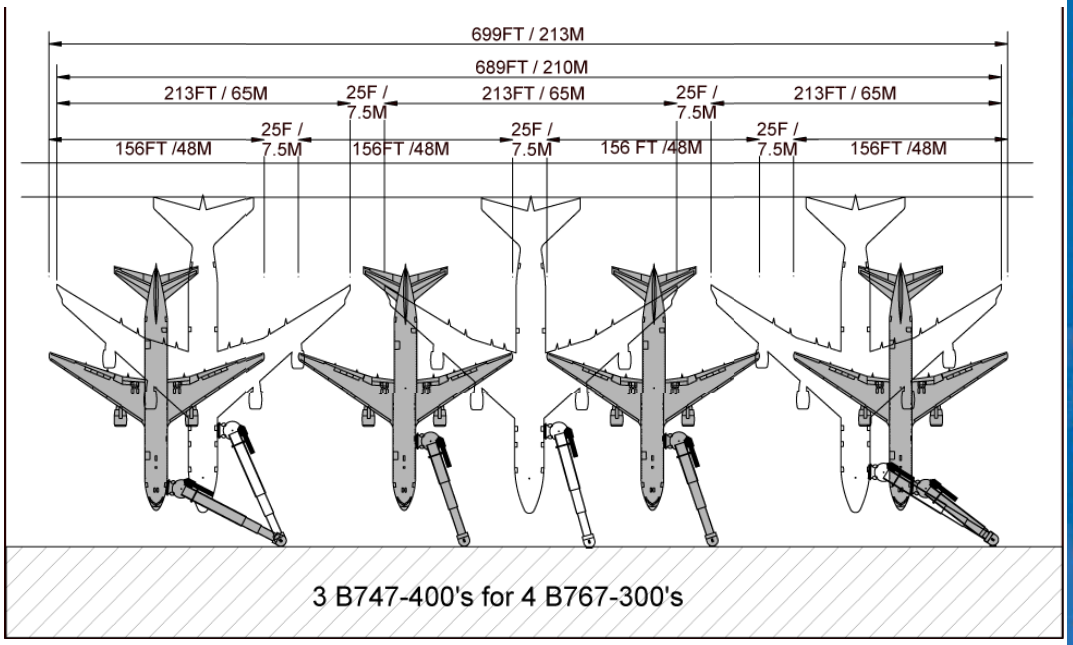
NarrowBody Equivalent Gate (NBEG) This metric is used to normalize the apron frontage demand and capacity to that of a typical NarrowBody aircraft gate. The amount of space each aircraft requires is based on the *maximum* wingspan of aircraft in its respective aircraft group.

Airplane Design Group (ADG)	Maximum Wingspan Feet	Maximum Wingspan Meters	NBEG	
I. Small Regional	49	15	0.4	 No. of Narrowbody Aircraft in wingspan of ADG I Aircraft = 0.4
II. Medium Regional	79	24	0.7	 No. of Narrowbody Aircraft in wingspan of ADG II Aircraft = 0.7
III. Narrowbody	118	36	1.0	 No. of Narrowbody Aircraft in wingspan of ADG III Aircraft = 1.0
IIIa. B757	135	41	1.1	 No. of Narrowbody Aircraft in wingspan of ADG IIIa Aircraft = 1.1
IV. Widebody	171	52	1.4	 No. of Narrowbody Aircraft in wingspan of ADG IV Aircraft = 1.4
V. Jumbo	214	65	1.8	 No. of Narrowbody Aircraft in wingspan of ADG V Aircraft = 1.8
VI. A380	262	80	2.2	 No. of Narrowbody Aircraft in wingspan of ADG VI Aircraft = 2.2

Chapter Highlights

CHAPTER 5:
TERMINAL AIRSIDE FACILITIES

1. **Airside Planning Requirements**
2. **Terminal Apron Planning**
3. **Aircraft Gate Requirements**



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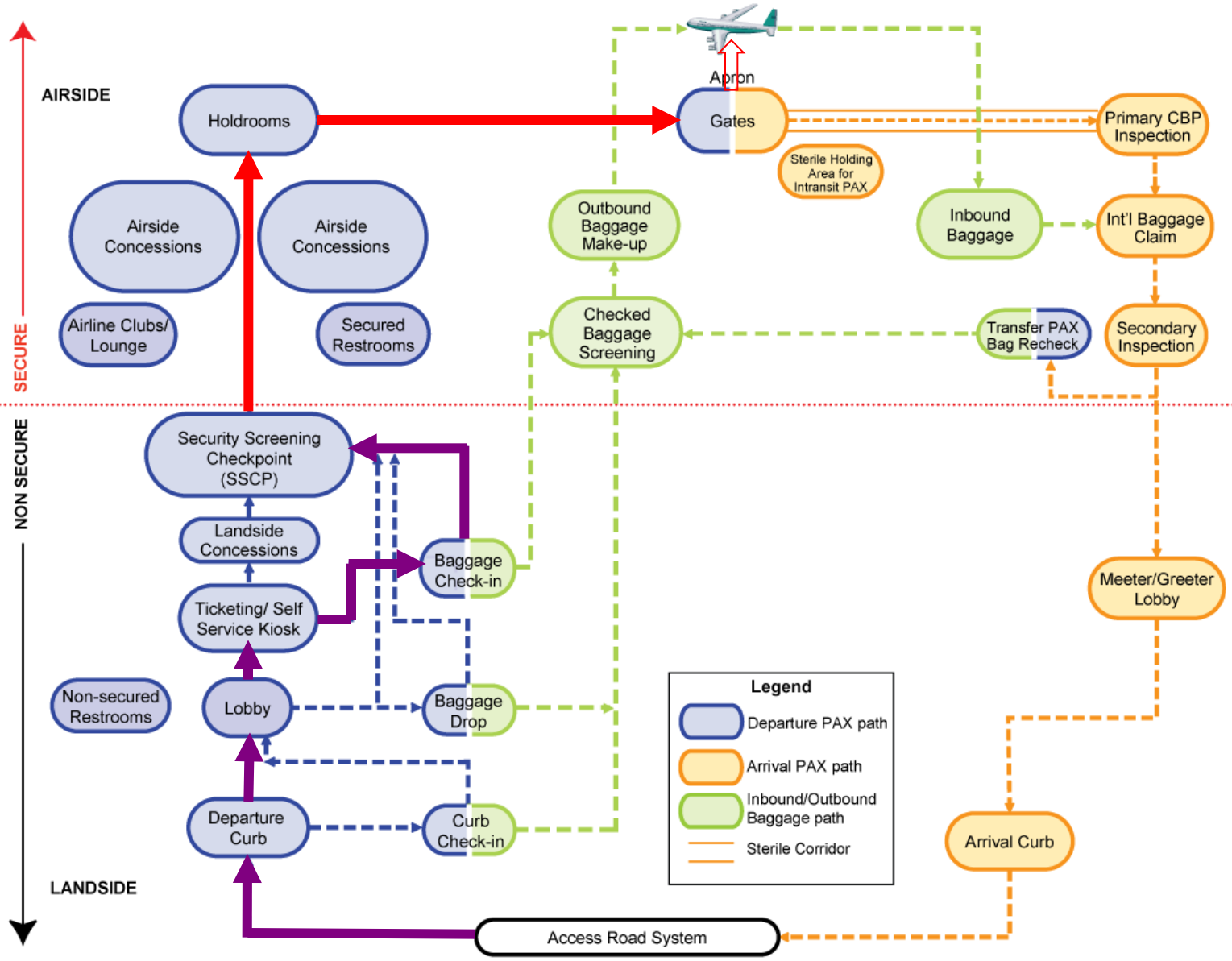

AIRSIDE
SECURE
NON SECURE
LANDSIDE
Apron
Holdrooms
Gates
Primary CBP Inspection
Sterile Holding Area for Intransit PAX
Airside Concessions
Airside Concessions
Outbound Baggage Make-up
Inbound Baggage
Int'l Baggage Claim
Airline Clubs/ Lounge
Secured Restrooms
Checked Baggage Screening
Transfer PAX Bag Recheck
Secondary Inspection
Security Screening Checkpoint (SSCP)
Landside Concessions
Baggage Check-in
Meeter/Greeter Lobby
Ticketing/ Self Service Kiosk
Non-secured Restrooms
Lobby
Baggage Drop
Departure Curb
Curb Check-in
Arrival Curb
Legend
Departure PAX path
Arrival PAX path
Inbound/Outbound Baggage path
Sterile Corridor
Access Road System

Chapter Highlights

CHAPTER 6: TERMINAL BUILDING FACILITIES

1. **Terminal Planning and Design Considerations**
2. **Terminal Concept Development**
3. **Terminal Facility Requirements**
4. **Other Facility Considerations**

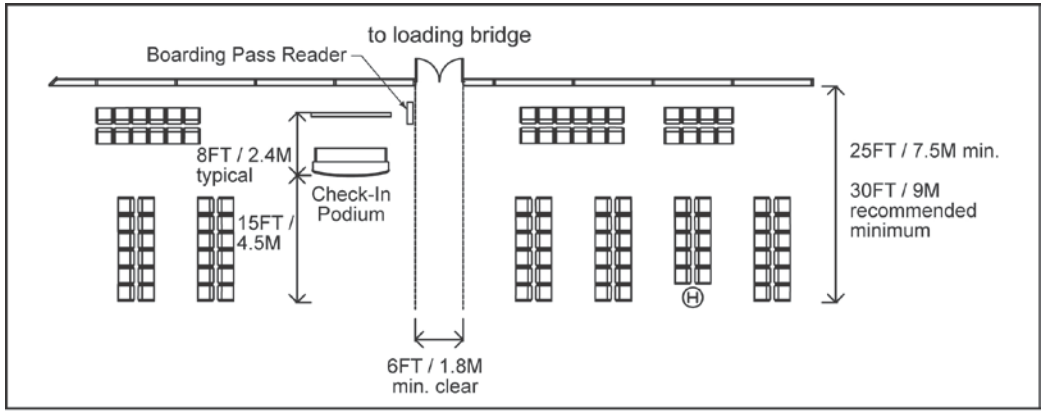


Figure VI-28 depicts a typical holdroom configuration.

Chapter Highlights

CHAPTER 7: TERMINAL LANDSIDE FACILITIES

1. **Transportation/ Traffic Planning**
2. **Intermodal Connections**
3. **Airport Roadway Systems**
4. **Terminal Curb Requirements**
5. **Parking Facility Requirements**
6. **Roadway/ Circulation Signage**
7. **Landside Security**

Drivers experience no interference from other vehicles or pedestrians. Motorists arriving at the airport terminal can stop adjacent to the curb at preferred locations. Demand is equal to or less than 0.50 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is unaffected.

Relatively free-flow conditions, although double-parking can be observed at some curbside locations (i.e., baggage check-in, major entrance/exit points). Demand is between 0.5 and 0.55 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is virtually unaffected.

Double-parking near doors is common and some intermittent triple-parking may occur. This level of service is appropriate for peak period design conditions at major airports. Demand is between 0.55 and 0.65 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is reduced by approximately 5% due to the increased frequency of double-parking.

Triple-parking occurs more frequently and vehicle maneuverability is somewhat restricted. Intermittent vehicle queues may form both in the through lanes and at the entrance to the curbside area. Demand is between 0.65 and 0.85 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is reduced by over 20% due to the increased frequency of double- and triple-parking.

LOS E—Motorists experience delays and queues along the length of the curbside. Both congestion and double- or triple-parking are evident throughout the curbside area. Momentary breakdowns in operation occur as traffic in the through lanes is increasingly delayed by vehicle maneuvering in and out of the parking lanes. Demand is between 0.85 and 1.0 of the double-parking capacity of the curbside. Capacity of adjacent through lanes is reduced by over 35% due to the increased frequency of double- and triple-parking.

LOS F—Motorists experience significant delays at the curbside entrance and along the length of the curbside. Parked vehicles are unable to leave the curbside due to stopped vehicles in adjacent lanes. Demand exceeds 1.0 of the double-parking capacity of the curbside. The flow of vehicles in all lanes frequently comes to a halt.

Note: Assumes a 4-lane curbside roadway where double parking is allowed.

Matt Lee
Landrum & Brown

ACRP REPORT 25

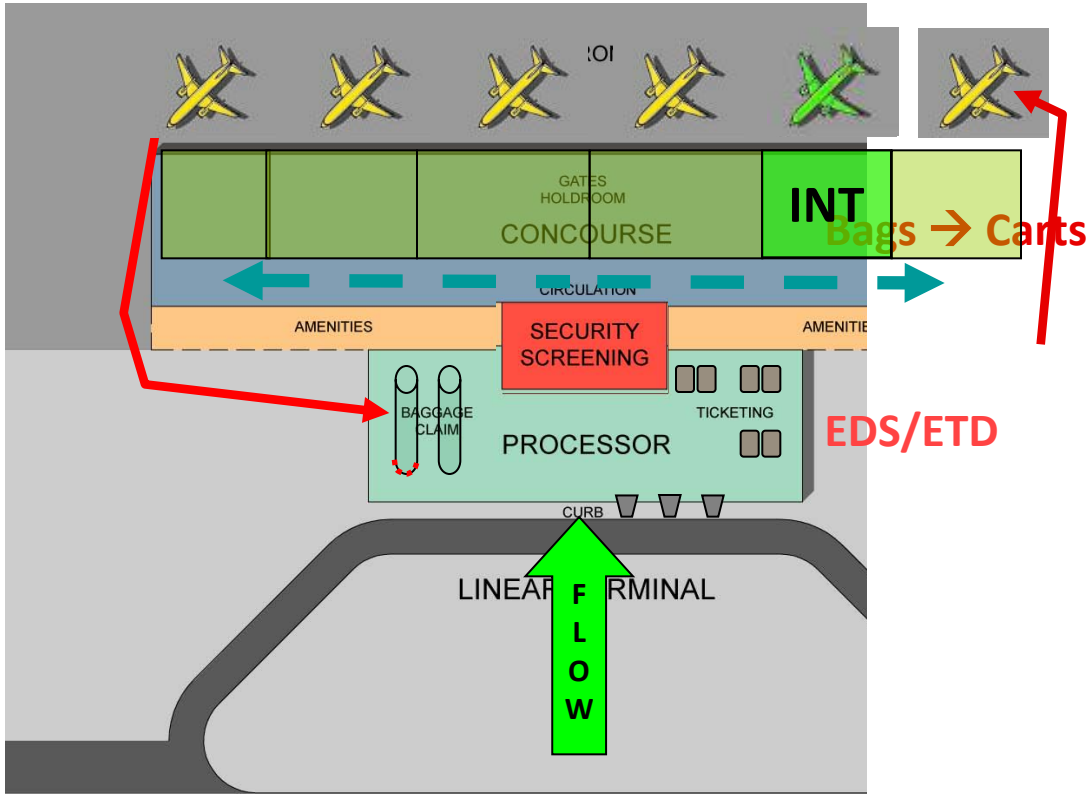
Airport Passenger Terminal Planning and Design

Volume 2: Spreadsheet Models

Spreadsheet Models Contents

- Created to supplement the learning and understanding of the planning principles in the Guidebook.
- Developed as simple Excel spreadsheet models for the purpose of learning basic planning principles as building blocks to more complex space programs.
- Developed in Excel 2003 and compatible with Excel 2000 or newer, and in Windows 2000 or newer and MAC OS.

Spreadsheet Model Contents:

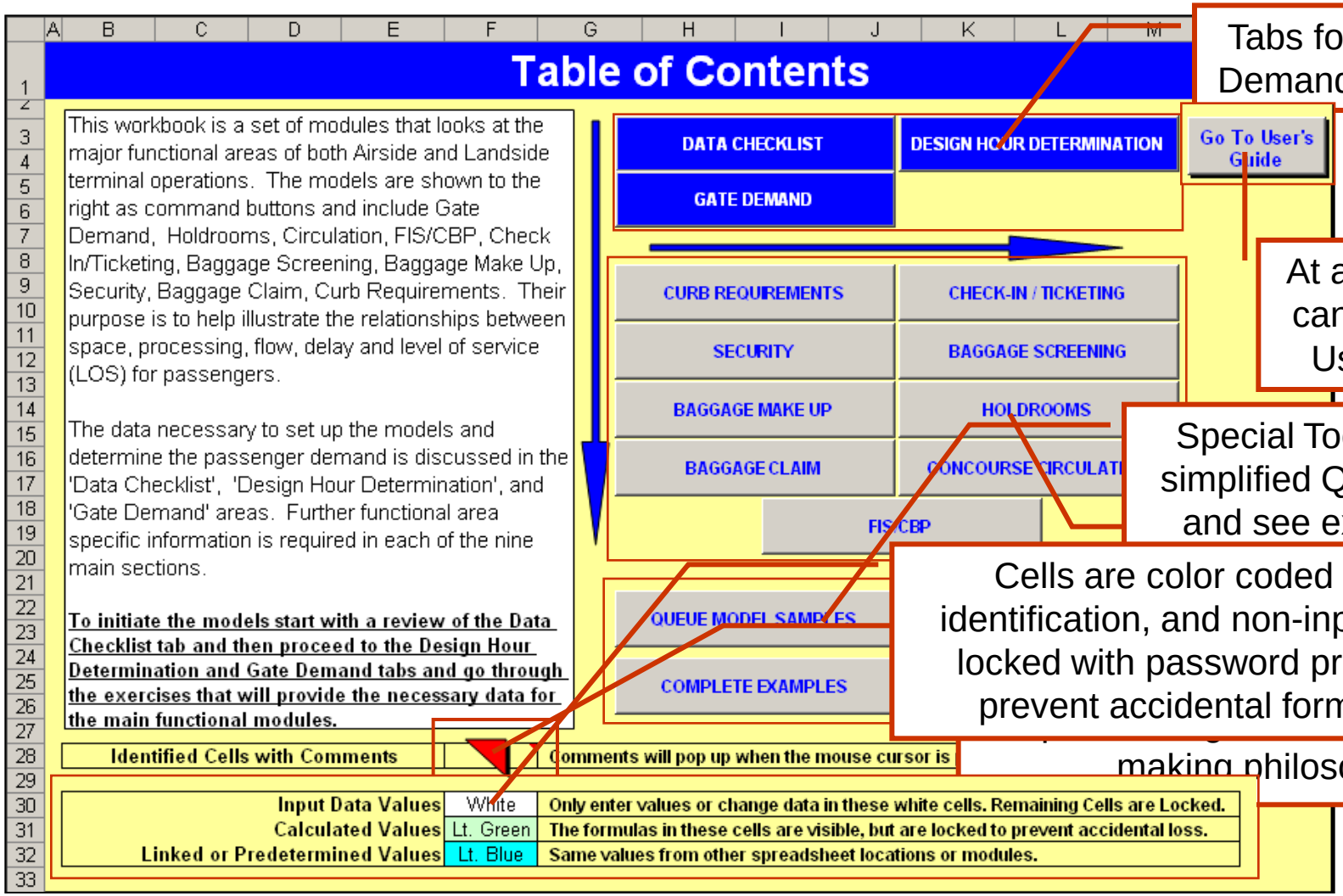


11 models are presented in the spreadsheet program

1. Design Hour Determination
2. Gate Requirements
3. Curbside Requirements
4. Ticketing/ Check-in
5. Baggage Screening
6. Bag Make Up
7. Security Screening
8. Holdrooms
9. CBP/FIS
10. Circulation
11. Baggage Claim

Spreadsheet Model Highlights:

TABLE OF CONTENTS



Tabs for developing Demand Parameters

At any point you can jump to the User's Guide

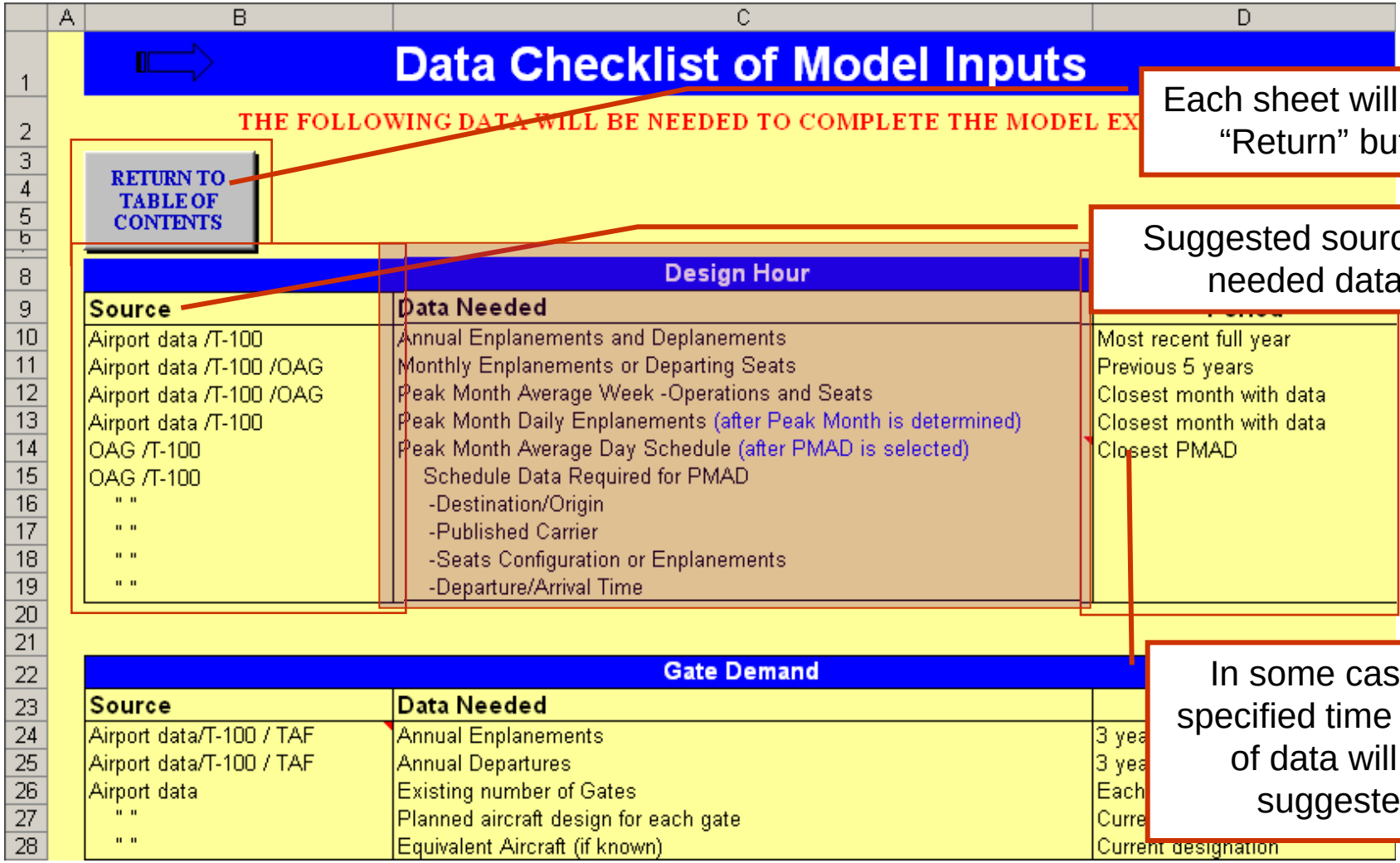
Special Tools – Use a simplified Queue model and see examples of

Cells are color coded for easy identification, and non-input cells are locked with password protection to prevent accidental formula loss.

making philosophy

Spreadsheet Model Highlights:

DATA CHECKLIST



Data Checklist of Model Inputs

THE FOLLOWING DATA WILL BE NEEDED TO COMPLETE THE MODEL EX

RETURN TO TABLE OF CONTENTS

Design Hour

Source	Data Needed	Period
Airport data /T-100	Annual Enplanements and Deplanements	Most recent full year
Airport data /T-100 /OAG	Monthly Enplanements or Departing Seats	Previous 5 years
Airport data /T-100 /OAG	Peak Month Average Week -Operations and Seats	Closest month with data
Airport data /T-100	Peak Month Daily Enplanements (after Peak Month is determined)	Closest month with data
OAG /T-100	Peak Month Average Day Schedule (after PMAD is selected)	Closest PMAD
OAG /T-100	Schedule Data Required for PMAD	
" "	-Destination/Origin	
" "	-Published Carrier	
" "	-Seats Configuration or Enplanements	
" "	-Departure/Arrival Time	

Gate Demand

Source	Data Needed	
Airport data/T-100 / TAF	Annual Enplanements	3 yea
Airport data/T-100 / TAF	Annual Departures	3 yea
Airport data	Existing number of Gates	Each
" "	Planned aircraft design for each gate	Curre
" "	Equivalent Aircraft (if known)	Current designation

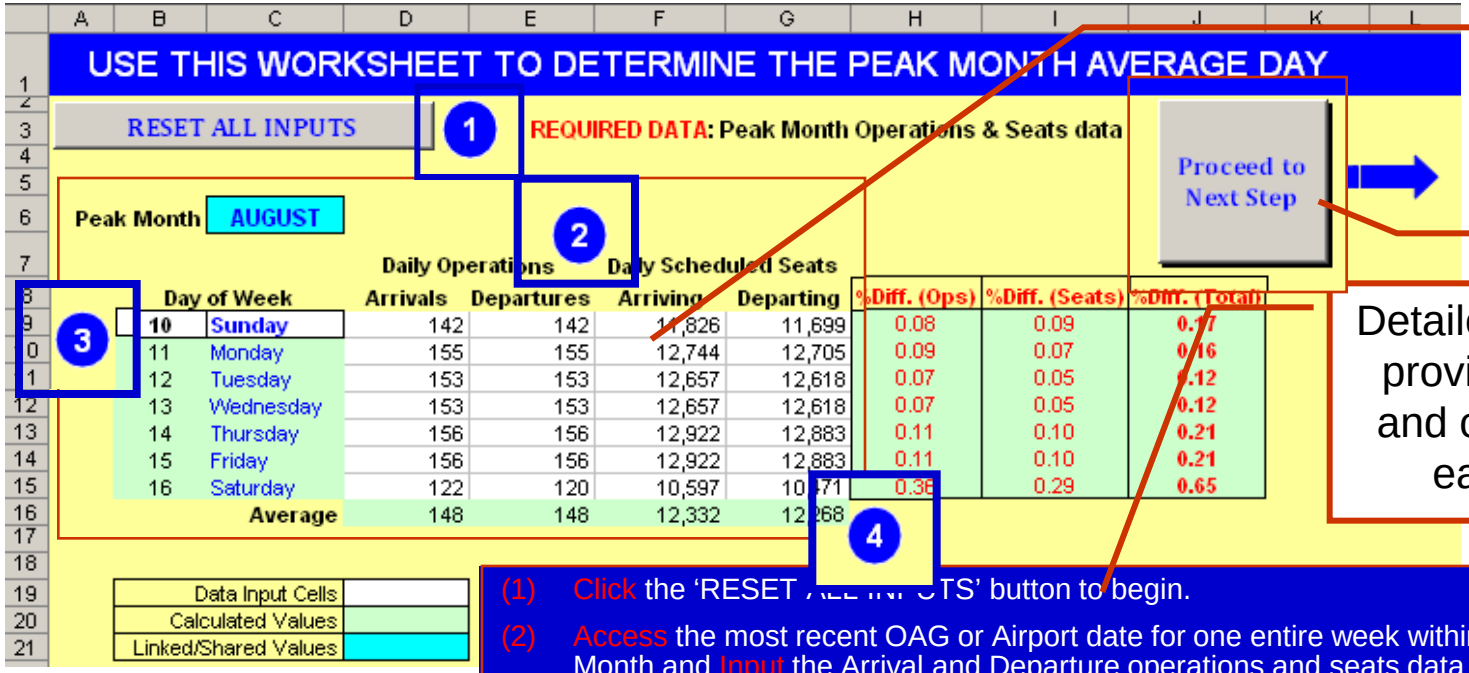
Each sheet will have a "Return" button

Suggested source for needed data.

In some cases a specified time period of data will be suggested

Spreadsheet Model Highlights:

DESIGN HOUR DETERMINATION



USE THIS WORKSHEET TO DETERMINE THE PEAK MONTH AVERAGE DAY

RESET ALL INPUTS (1)

REQUIRED DATA: Peak Month Operations & Seats data

Proceed to Next Step

Peak Month: AUGUST (2)

(3)	Day of Week		Daily Operations: Arrivals	Daily Operations: Departures	Daily Scheduled Seats: Arriving	Daily Scheduled Seats: Departing	%Diff. (Ops)	%Diff. (Seats)	%Diff. (Total)
	10	Sunday	142	142	11,826	11,699	0.08	0.09	0.17
	11	Monday	155	155	12,744	12,705	0.09	0.07	0.16
	12	Tuesday	153	153	12,657	12,618	0.07	0.05	0.12
	13	Wednesday	153	153	12,657	12,618	0.07	0.05	0.12
	14	Thursday	156	156	12,922	12,883	0.11	0.10	0.21
	15	Friday	156	156	12,922	12,883	0.11	0.10	0.21
	16	Saturday	122	120	10,597	10,471	0.36	0.29	0.65
		Average	148	148	12,332	12,268			

(4)

Data Input Cells
Calculated Values
Linked/Shared Values

Input Data

Each tab follows the same process: Reset, Input, Proceed

Detaile… provi… and c… each step simple

(1) Click the 'RESET ALL INPUTS' button to begin.

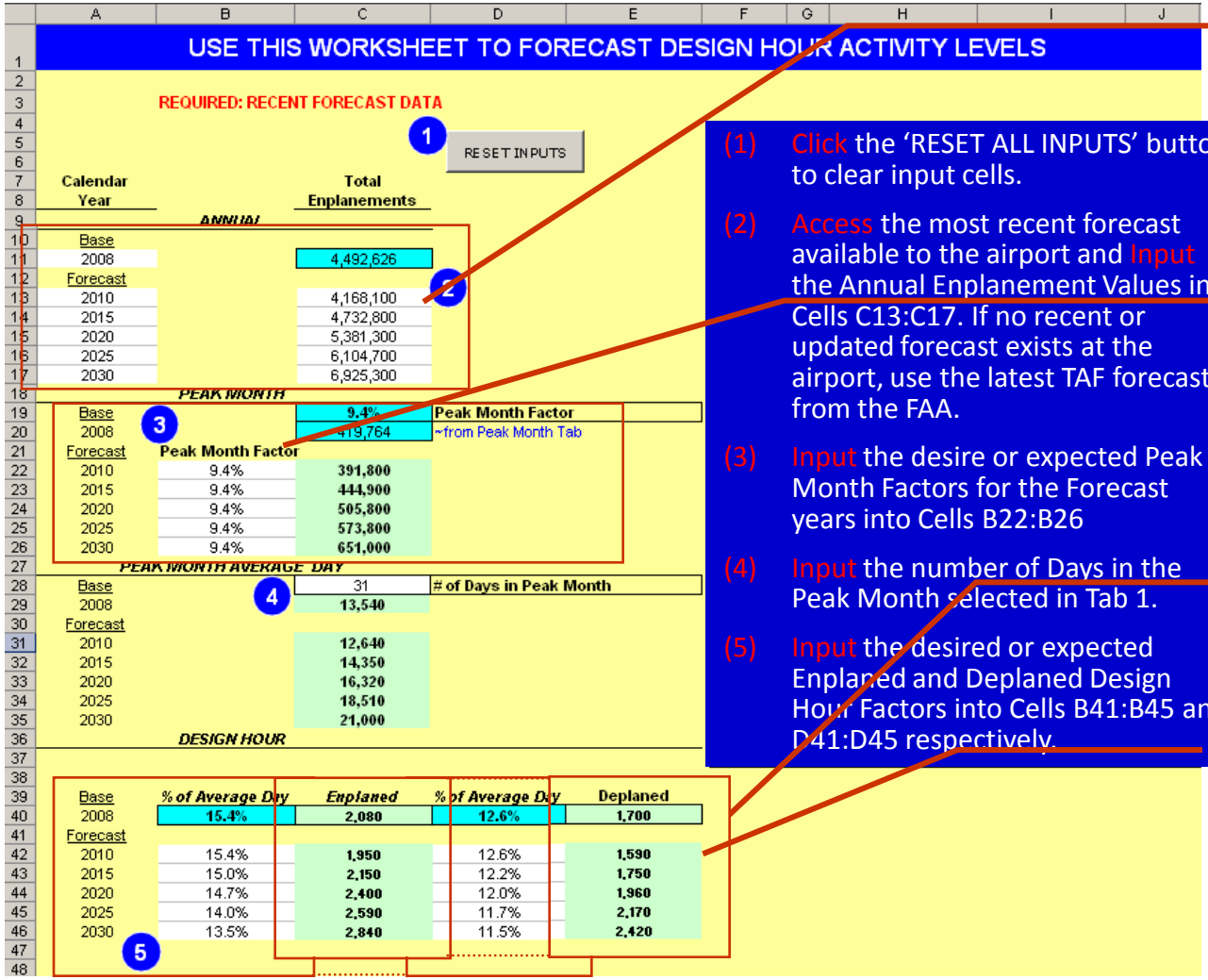
(2) Access the most recent OAG or Airport date for one entire week within the Peak Month and Input the Arrival and Departure operations and seats data into Cells D9 : G15 in the worksheet. This week should not contain any holidays.

(3) Input the date of the first day of the selected week and Select the first day of the month from the dropdown list in Cells B9 and C9 and the remaining cells will auto fill.

(4) Select a day of the sample week as the average day of the month that closely matches the average weekday. Use the % difference values in H9:J15 to help choose the average day. Avoid any holidays or other anomalies.

(5) Access the most recent OAG or Airport data for the Peak Month Average Day. This data will include 1) Origin or Destination, 2) Time of Departure or Arrival, 3) Seat Configuration, and 4) Published Carrier.

Spreadsheet Model Highlights:
DESIGN HOUR DETERMINATION



USE THIS WORKSHEET TO FORECAST DESIGN HOUR ACTIVITY LEVELS

REQUIRED: RECENT FORECAST DATA

1 RESET INPUTS

Calendar Year	Total Enplanements
ANNUAL	
Base	
2008	4,492,626
Forecast	
2010	4,168,100
2015	4,732,800
2020	5,381,300
2025	6,104,700
2030	6,925,300

2

PEAK MONTH

Base		9.4%	Peak Month Factor
2008		419,764	~from Peak Month Tab
Forecast	Peak Month Factor		
2010	9.4%	391,800	
2015	9.4%	444,900	
2020	9.4%	505,800	
2025	9.4%	573,800	
2030	9.4%	651,000	

3

PEAK MONTH AVERAGE DAY

	31	# of Days in Peak Month
Base		
2008	13,540	
Forecast		
2010	12,640	
2015	14,350	
2020	16,320	
2025	18,510	
2030	21,000	

4

DESIGN HOUR

Base	% of Average Day	Enplaned	% of Average Day	Deplaned
2008	15.4%	2,080	12.6%	1,700
Forecast				
2010	15.4%	1,950	12.6%	1,590
2015	15.0%	2,150	12.2%	1,750
2020	14.7%	2,400	12.0%	1,960
2025	14.0%	2,590	11.7%	2,170
2030	13.5%	2,840	11.5%	2,420

5

(1) Click the 'RESET ALL INPUTS' button to clear input cells.

(2) Access the most recent forecast available to the airport and Input the Annual Enplanement Values in Cells C13:C17. If no recent or updated forecast exists at the airport, use the latest TAF forecast from the FAA.

(3) Input the desire or expected Peak Month Factors for the Forecast years into Cells B22:B26

(4) Input the number of Days in the Peak Month selected in Tab 1.

(5) Input the desired or expected Enplaned and Deplaned Design Hour Factors into Cells B41:B45 and D41:D45 respectively.

Input most recent forecast data

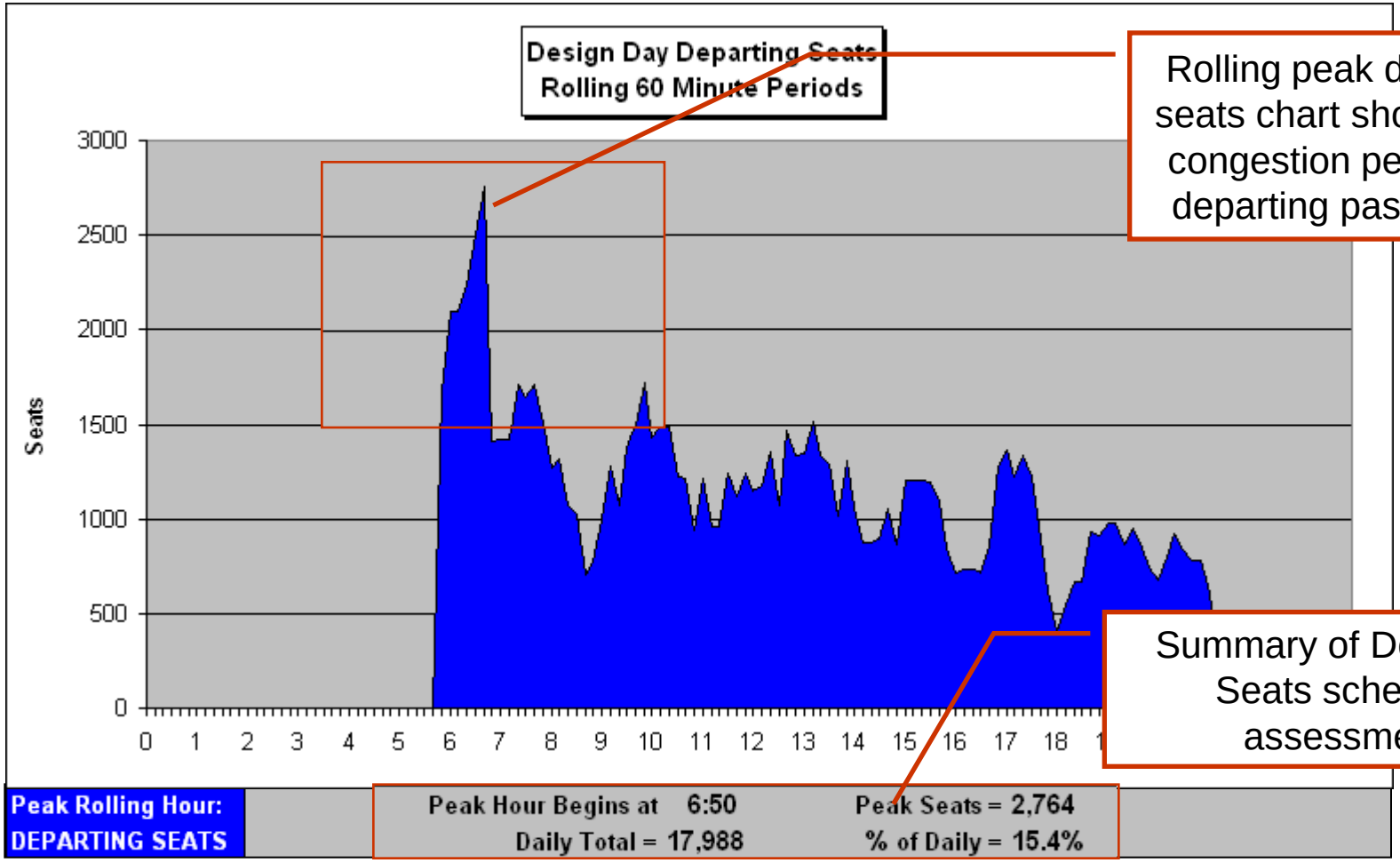
Choose peak month factor levels for forecast period

Choose percent of average day levels to based on expectation of

Results are the Design Hour enplaning and deplaning values to use in the other models

Spreadsheet Model Highlights:

DESIGN HOUR DETERMINATION

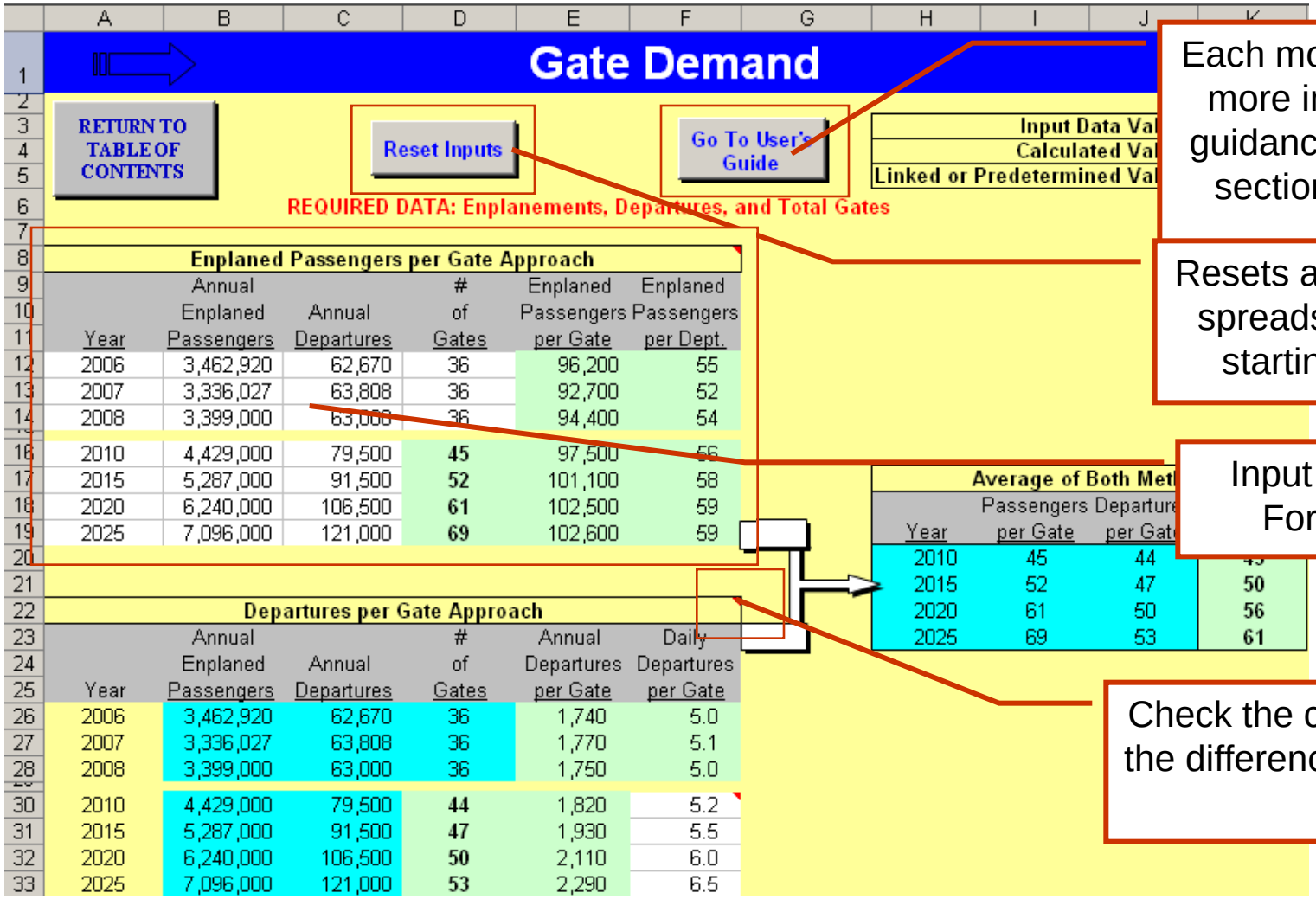


Rolling peak departing seats chart shows likely congestion periods for departing passengers

Summary of Departing Seats schedule assessment

Spreadsheet Model Highlights:

GATE DEMAND



Gate Demand

RETURN TO TABLE OF CONTENTS | Reset Inputs | Go To User's Guide

Input Data Val
Calculated Val
Linked or Predetermined Val

REQUIRED DATA: Enplanements, Departures, and Total Gates

Enplaned Passengers per Gate Approach

Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Enplaned Passengers per Gate	Enplaned Passengers per Dept.
2006	3,462,920	62,670	36	96,200	55
2007	3,336,027	63,808	36	92,700	52
2008	3,399,000	63,000	36	94,400	54
2010	4,429,000	79,500	**45**	97,500	56
2015	5,287,000	91,500	**52**	101,100	58
2020	6,240,000	106,500	**61**	102,500	59
2025	7,096,000	121,000	**69**	102,600	59

Departures per Gate Approach

Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Annual Departures per Gate	Daily Departures per Gate
2006	3,462,920	62,670	36	1,740	5.0
2007	3,336,027	63,808	36	1,770	5.1
2008	3,399,000	63,000	36	1,750	5.0
2010	4,429,000	79,500	**44**	1,820	5.2
2015	5,287,000	91,500	**47**	1,930	5.5
2020	6,240,000	106,500	**50**	2,110	6.0
2025	7,096,000	121,000	**53**	2,290	6.5

Average of Both Met

Year	Passengers per Gate	Departure per Gat	
2010	45	44	
2015	52	47	**50**
2020	61	50	**56**
2025	69	53	**61**

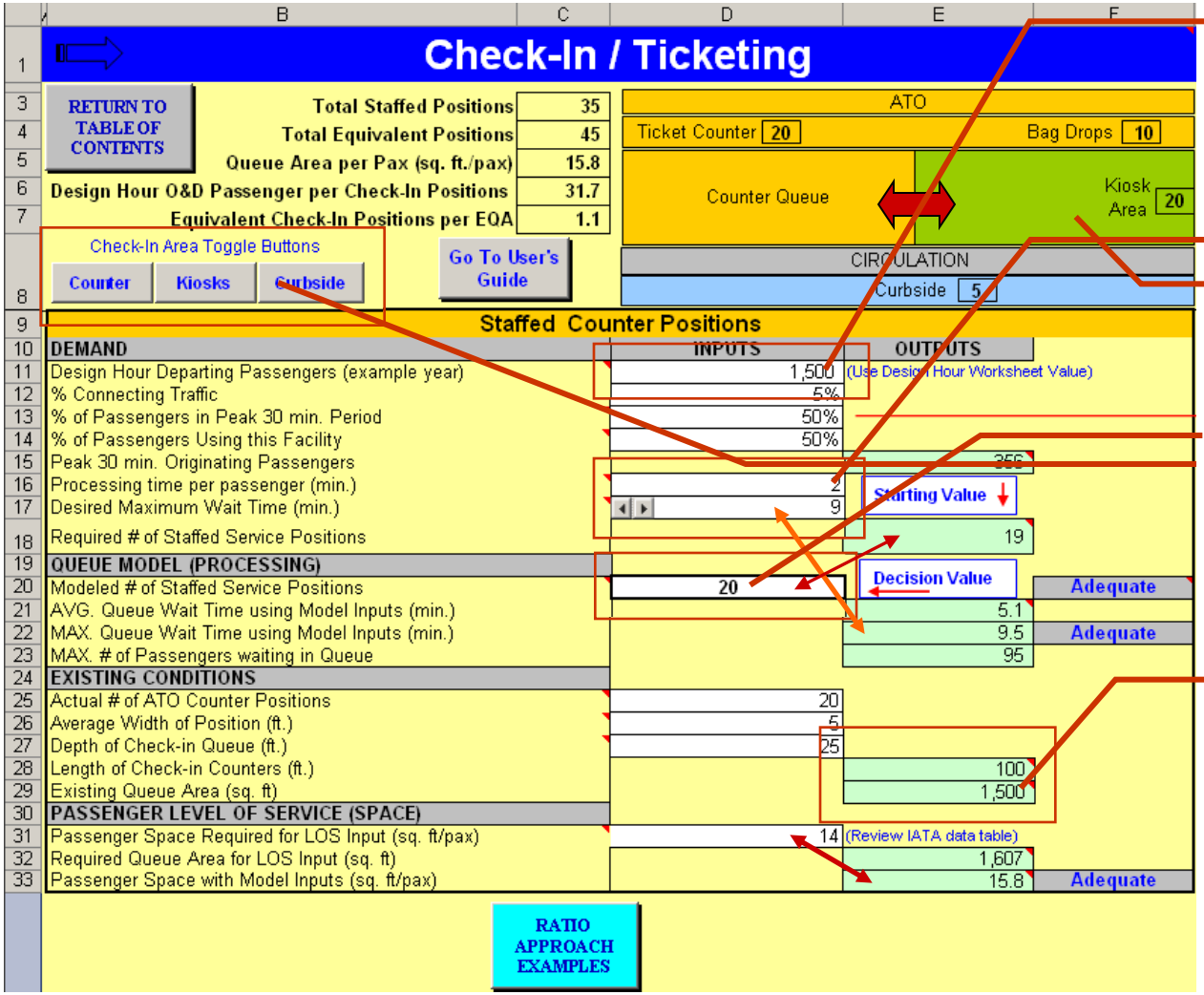
Each model has a link to more information and guidance in appropriate section of the User's Guide

Resets are used in some spreadsheets to make starting over easier

Input existing and Forecast data

Check the comments to see the difference in approaches

Spreadsheet Model Highlights:
CHECK-IN/TICKETING



Linked to Design Hour Worksheet

Input known and desired

Interactive Drawing: Area changes as values change in the spreadsheet

Repeat the process for Kiosks and Curbside check-in to create a summary of Check-In Requirements

queue size, wait times, and queue area requirements based on number of positions

Spreadsheet Model Highlights:

CHECK-IN/TICKETING

36		Kiosks		
37	DEMAND	INPUTS	OUTPUTS	
38	Design Hour Departing Passengers	1,500		
39	% Connecting Traffic	5%		
40	% of Passengers in Peak 30 Min. Period	50%		
41	% of Passengers Using this Facility	40%		
42	Peak 30 Minute Originating Passengers		285	
43	Processing time per passenger (min.)	1.5		
44	Desired Maximum Wait Time (min.)	2		
45	Required # of Available Counter Positions		14	
46	QUEUE MODEL (PROCESSING)			
47	Modeled # of Available Service Positions	20		Adequate
48	AVG. Queue Wait Time using Model Inputs (min.)		0.2	
49	MAX. Queue Wait Time using Model Inputs (min.)		1.1	Adequate
50	MAX. # of Passengers waiting in Queue		15	
51	Kiosks served per each staffed Bag Drop	2		
52	Required # of Bag Drop Positions		10	
53	REQUIRED QUEUE AREA (L.O.S. "C") (sq. ft)			
54	Actual # of Total Counter Positions			
55	Average Width of Position (ft.)			
56	Depth of Check-in Queue (ft.)			
57	Linear Kiosk Length (Equivalent Counter Length) (ft.)			
58	Existing Queue Area (sq. ft)			
59	PASSENGER LEVEL OF SERVICE (SPACE)			
60	Desired Passenger Space for L.O.S. (sq. ft/pax)			
61	Required Queue Area for L.O.S. (sq. ft)			
62	Passenger Space with Model Inputs (sq. ft/pax)			

Kiosk and Curbside

The dashboard at the top of the spreadsheet tab summarizes the number of determined positions and some useful design factors

	B	C	D	E	F
1	Check-In / Ticketing				
3	RETURN TO TABLE OF CONTENTS	Total Staffed Positions	35	ATO	
4		Total Equivalent Positions	45	Ticket Counter 20	Bag Drops 10
5		Queue Area per Pax (sq. ft./pax)	15.8	Counter Queue	Kiosk Area 20
6		Design Hour O&D Passenger per Check-In Positions	31.7		
7		Equivalent Check-In Positions per EQA	1.1		
	Check-In Area Toggle Buttons	Go To User's Guide		CIRCULATION	
8	Counter Kiosks Curbside			Curbside 5	

65		Curbside		
66	DEMAND		INPUTS	OUTPUTS
67	Design Hour Departing Passengers		1,500	
68	% Connecting Traffic		5%	
69	% of Passengers in Peak 30 Min. Period		50%	
70	% of Passengers Using this Facility		10%	
71	Peak 30 Minute Originating Passengers			71
72	Processing time per passenger (min.)		2	
73	Desired Maximum Wait Time (min.)		5	
74	Required # of Available Counter Positions			5
75	EXISTING CONDITIONS			
76	Actual # of Staffed Curbside Positions		5	
77	Average Width of Position (ft.)		5.25	
78	Depth of Curbside Check-in (ft.)		20	
79	Length of Check-in Counters (ft.)			26
80	Total Curbside Check-in Area (sq. ft)			263
81				
82		Space Summary		
83	ATO Airline Office Space	depth (ft)	20	2,000 sq. ft
84	ATO Counter Area	depth (ft)	10	1,000 sq. ft
85	Active Check In Zone	depth (ft)	10	
86	Active Check In Zone Area			1,000 sq. ft
87	Counter Queue			2,500 sq. ft
88	Kiosk Area			900 sq. ft
89	Curbside Area			525 sq. ft
90	Cross Circulation	depth (ft)	20	2,720 sq. ft
91	Total Check-in/Ticketing Area			10,645 sq. ft

Space requirements associated with the number of positions are provided in a Space Summary for Check-In

Spreadsheet Model Highlights:

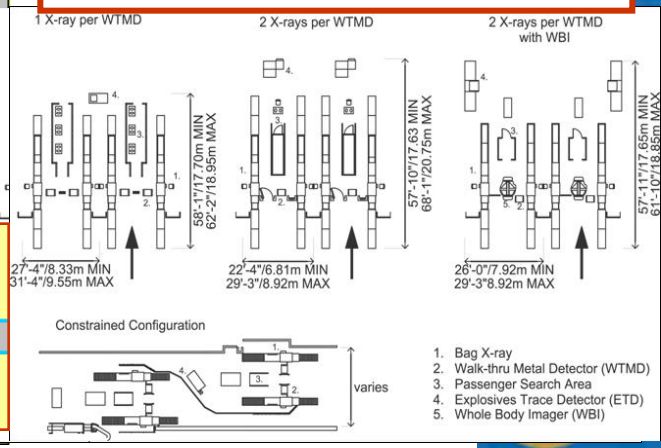
SECURITY SCREENING

	A	B	C	D	E	F
1	**Security Screening**					
2						
3	RETURN TO TABLE OF CONTENTS	Go To User's Guide		Input Data Values		
4				Calculated Values		
5				Linked or Predetermined Values		
6						
7	**DEMAND**	**INPUTS**	**OUTPUTS**			
8	*Use throughput value from Check-In Model*	750				
9	Peak 30 min Originating Passengers from Check-In	713	linked to Check In/ Ticketing			
10	% Additional Traffic (non-passenger, employees, crew)	15%				
11	Total Peak Period Security Traffic (passengers)		819			
12	Throughput Rate (Passengers/Hour per lane)	175				
13	# of Passengers Processed/minute per lane		2.9			
14	Maximum Target Wait Time (in Queue)	8				
15	Minimum Required # of Screening Lanes		8	Starting Value		
16	**QUEUE MODEL FOR REQUIRED SCREENING LANES**					
17	# of Screening Lanes for Queue Model Input	11		Decision Value		
18	Max. Wait Time in Queue (Min.)		2.7	Adequate # of Lanes		
19	**EXISTING CONDITIONS**					
20	Depth of Security Queue (ft)	20				
21	Width of Scanning Lane Module (2 Lanes) (ft.)	25				
22	Overall Length of Check Point Area (ft)	40				
23	Reconciliation Area Depth (ft)	10				
24	**SPACE REQUIREMENTS**					
25	Security Queue Area (sq. ft)		2,750			
26	Passengers in Queue based on Queue Wait Time		87			
27	Passenger Space Required for LOS Input (sq. ft/pax)	10.8	(Review the IATA Table)			
28	Required Security Queue Area for LOS Input (sq. ft)		945			
29	Passenger Space with Current Dimensions (sq. ft/pax)		31.4	Adequate Queue Area		
30	Total Checkpoint Area ~tables, equipment, search area (sq. ft)		6,875			
31	Total Security Screening Area (sq. ft)		9,625			
32						

Input percent of passengers in Peak Period (use 30 min.)

Input Throughput rate which will need to be an observed rate

Adjust queue model input and observe flow and space conditions



Spreadsheet Model Highlights:

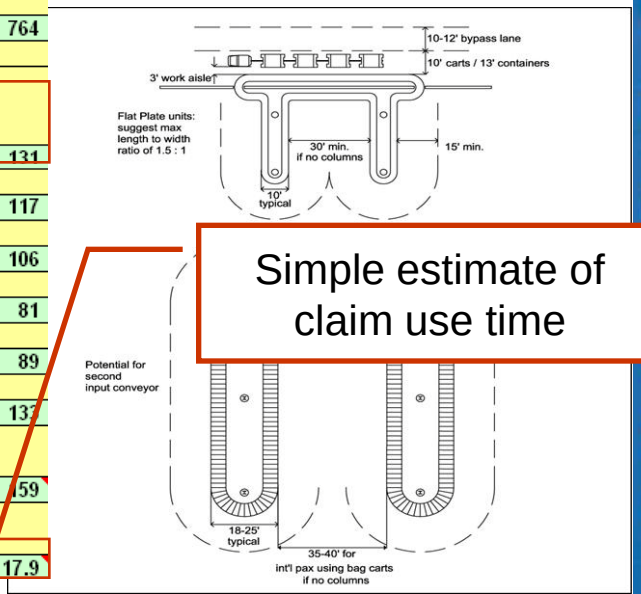
BAGGAGE CLAIM

	A	B	C	D	E
1	**Baggage Claim**				
2					
3	RETURN TO TABLE OF CONTENTS	Go To User's Guide		Input Data Values	
4				Calculated Values	
5				Linked or Predetermined Values	
6					
7	**DEMAND**			**INPUTS**	**OUTPUTS**
8	Peak Hour Deplaning Passengers	*User Specified Input*	1,500	1,500	link to Design Hour
9	Percent Deplaning in Peak 20 Min.			50%	
10	Percent Terminating Passengers			90%	
11	Peak 20 Min. Terminating Passengers				675
12	Percentage of Passengers Checking Bags			90%	
13	Passengers Checking Bags				608
14	Average Traveling Party Size			1.3	
15	Number of Parties				467
16	Percent Additional Passengers at Claim			30%	
17	Total People at Claim				509
18	Claim Frontage per Person (ft)			1.5	
19	Total Claim Frontage Required (ft)				764
20					
21	**TYPICAL SINGLE AIRCRAFT CLAIM UNIT SIZE**				
22	Typical Aircraft Seating Capacity			145	
23	Design Hour Load Factor			90%	
24	Typical Aircraft Passenger Load				131
25	Percent Terminating Passengers			90%	
26	Peak 20 Min. Terminating Passengers				117
27	Percentage of Passengers Checking Bags			90%	
28	Passengers Checking Bags				106
29	Average Traveling Party Size			1.3	
30	Number of Parties				81
31	Percent Additional Passengers at Claim			30%	
32	Total People at Claim				89
33	Claim Frontage per Person (ft)			1.5	
34	Claim Frontage Required per Flight				133
35	**BAGGAGE CLAIM USE TIME (domestic only)**				
36	Average # of bags per passenger checking bags			1.5	
37	Total # bags to unload at Baggage Claim				159
38	Flight Buffer to allow for late pick up of bags (min)			10	
39	Unload Rate of bags at Claim (bags/min)			20	
40	Claim Use Time estimate (min)				17.9

Input O&D Data to determine passengers claiming bags

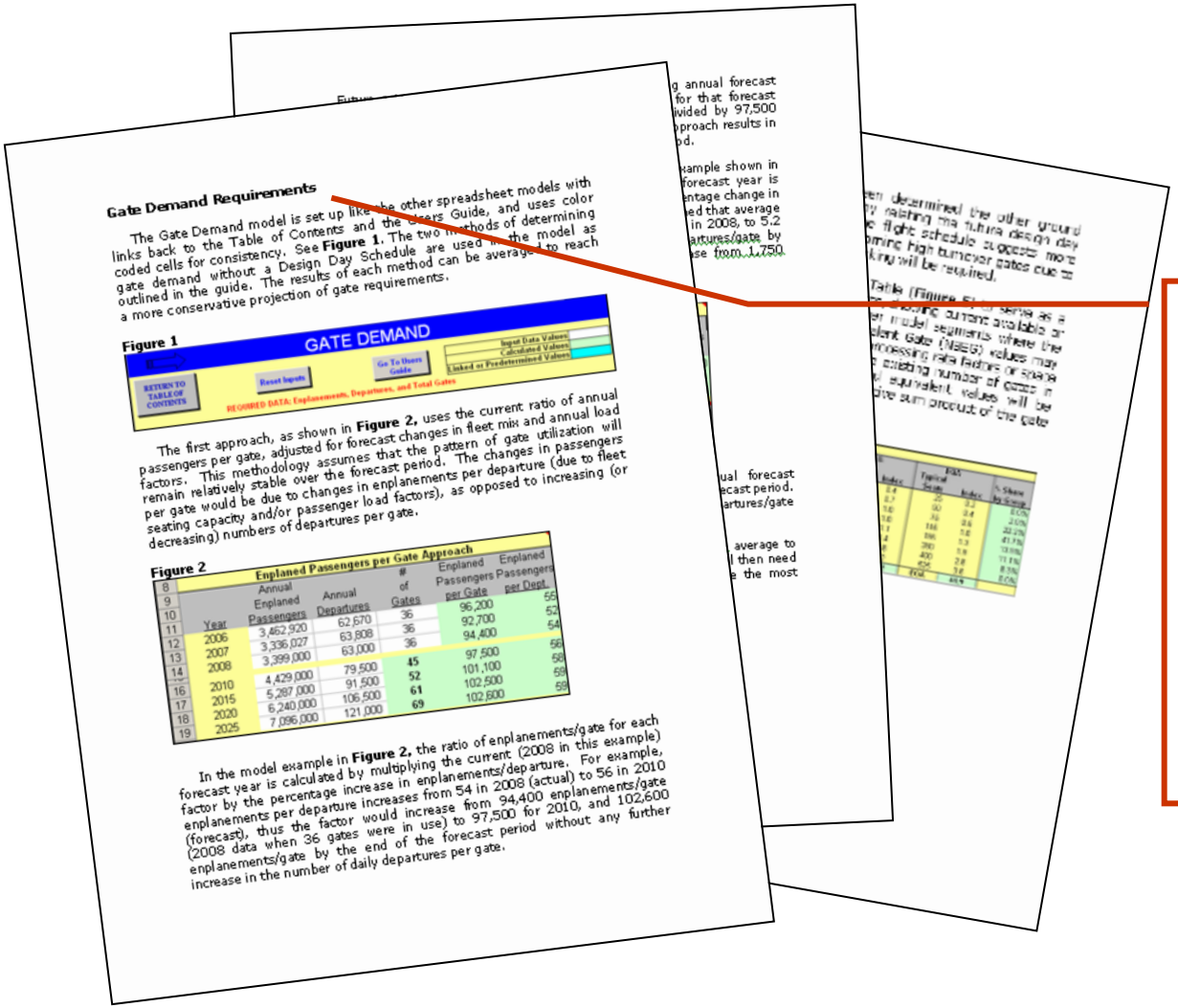
Input Survey Data to estimate total claim frontage required

Follow the same process as above to size a single claim unit



Simple estimate of claim use time

Spreadsheet Model Highlights:
USER'S GUIDE EXAMPLE



Gate Demand Requirements

The Gate Demand model is set up like the other spreadsheet models with links back to the Table of Contents and the Users Guide, and uses color coded cells for consistency. See **Figure 1**. The two methods of determining gate demand without a Design Day Schedule are used in the model as outlined in the guide. The results of each method can be averaged to reach a more conservative projection of gate requirements.

Figure 1

GATE DEMAND

The first approach, as shown in **Figure 2**, uses the current ratio of annual passengers per gate, adjusted for forecast changes in fleet mix and annual load factors. This methodology assumes that the pattern of gate utilization will remain relatively stable over the forecast period. The changes in passengers per gate would be due to changes in enplanements per departure (due to fleet seating capacity and/or passenger load factors), as opposed to increasing (or decreasing) numbers of departures per gate.

Figure 2

Enplaned Passengers per Gate Approach

Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Enplaned Passengers per Gate	Enplaned Passengers per Dept.
2006	3,462,920	62,670	36	96,200	55
2007	3,336,027	63,808	36	92,700	52
2008	3,399,000	63,000	36	94,400	54
2010	4,429,000	79,500	45	97,500	56
2015	5,287,000	91,500	52	101,100	58
2020	6,240,000	106,500	61	102,500	59
2025	7,096,000	121,000	69	102,600	59

In the model example in **Figure 2**, the ratio of enplanements/gate for each forecast year is calculated by multiplying the current (2008 in this example) factor by the percentage increase in enplanements/departure. For example, enplanements per departure increases from 54 in 2008 (actual) to 56 in 2010 (forecast), thus the factor would increase from 94,400 enplanements/gate (2008 data when 36 gates were in use) to 97,500 for 2010, and 102,600 enplanements/gate by the end of the forecast period without any further increase in the number of daily departures per gate.

Each User's Guide section provides a more detailed and specific set of instructions on how to proceed through the steps of the model as well as provides additional background information and excerpts from the Guidebook.

Potential Value and Lessons Learned

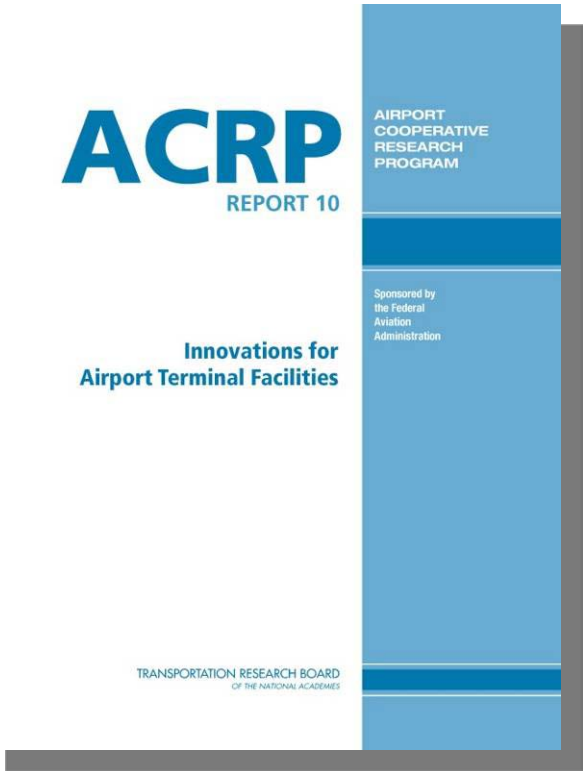
- A major step forward from not having any U.S. focused Guidebook for airport terminals for over 20 years, this however should be an initial step in a continuing evolution for a comprehensive Guidebook

- In a sense the Guidebook and Spreadsheets research reflects a current slice in time where the ACRP 07-01, “Innovations for Airport Terminal Facilities” looks ahead to the future with new and creative planning ideas as compared to current “tried and true” industry accepted guidelines.

Report 10: Innovations for Airport Terminal Facilities

ACRP Project 07-01

- Research Agency:
  - Corgan Associates
- Principal Investigator:
  - Phil Mein
- Subcontractors:
  - Ricondo & Associates
  - TransSolutions, LLC
  - TranSecure LLC



Phil Mein

Corgan Associates, Inc.

ACRP Report 07–01
Airport Terminal Planning and Innovative Facilities

Introduction

- Project Objectives
  - To develop new concepts for airport terminal landside facilities that:
    - Improve the passenger experience
    - Stimulate innovative design solutions
    - Address the needs of the elderly traveler
    - Are implementable within a 5-10 year time frame

- Context
  - Changing demographics and their influence on travel patterns
  - Empowerment of the passenger through technology and self service
  - Processed based planning and its impact on passenger movement
  - The need to cost effectively reduce congestion in terminals and at roadways

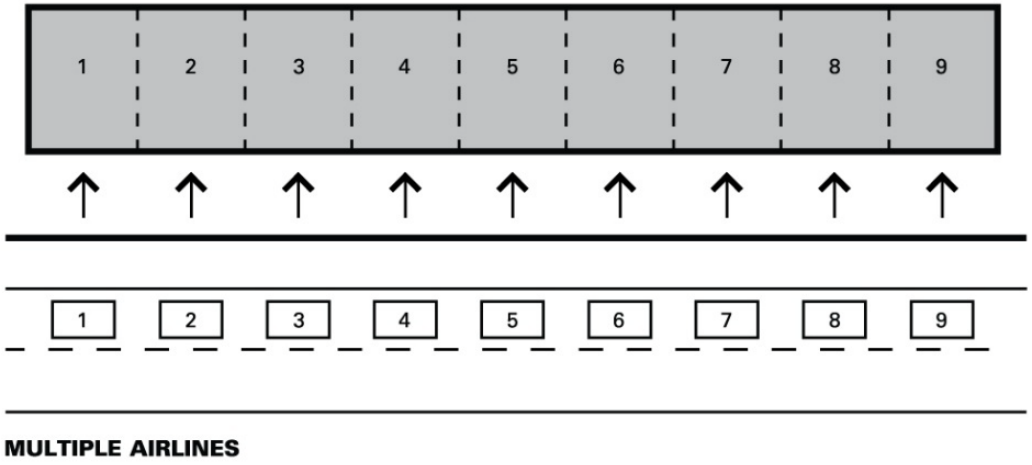
Key Issues for Passengers

- Waiting / Queuing
- Walking / Vertical Transitions
- Baggage Handling by Passengers
- Information / Signage / Wayfinding
- Vehicular Movement / Pickup / Drop-off
- Safety and Security

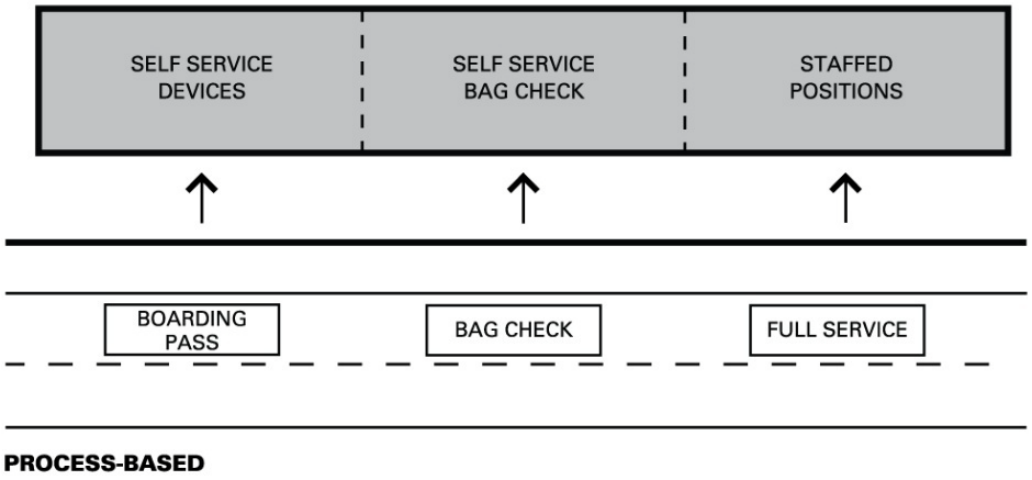
Terminal Innovations

- Process-based Departures Hall
- Self-service Baggage Check
- Check-in Alternatives
- Low-profile Passenger Baggage Devices
- High-capacity Flow-through Elevators
- Consolidated Meeters and Greeters Area
- Arrivals Hall
- Arrivals Lounges

Process-based Departures Hall

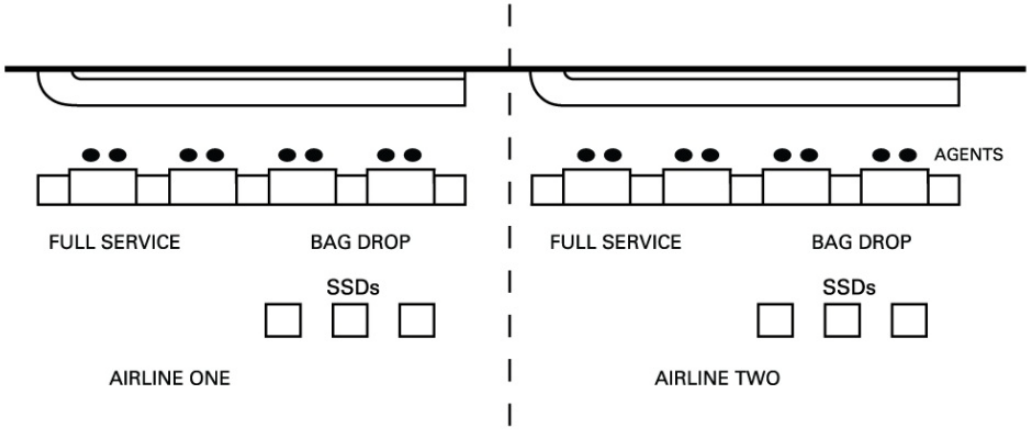


MULTIPLE AIRLINES

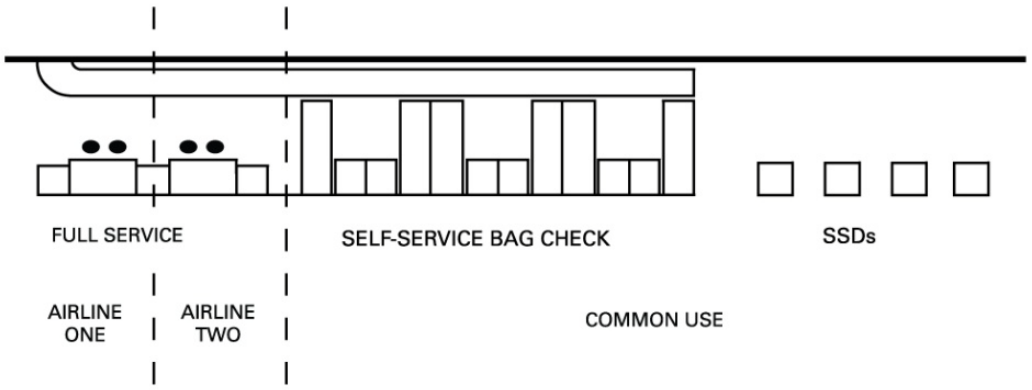


PROCESS-BASED

Self-service Baggage Check



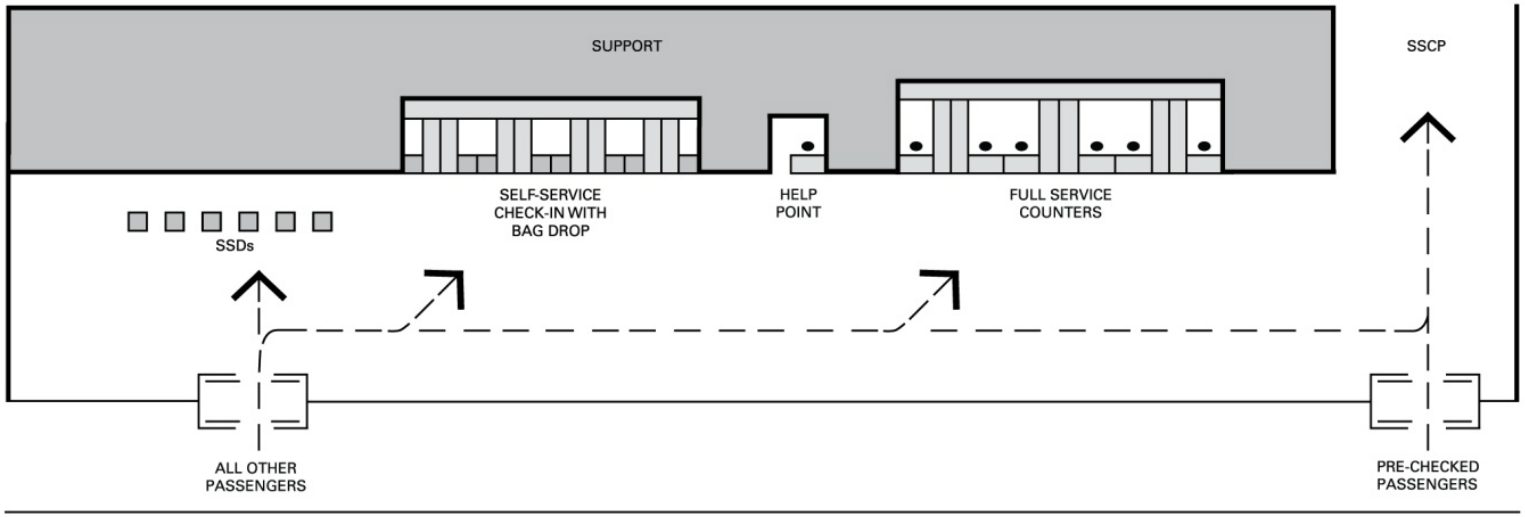
CURRENT TWO STEP SYSTEM



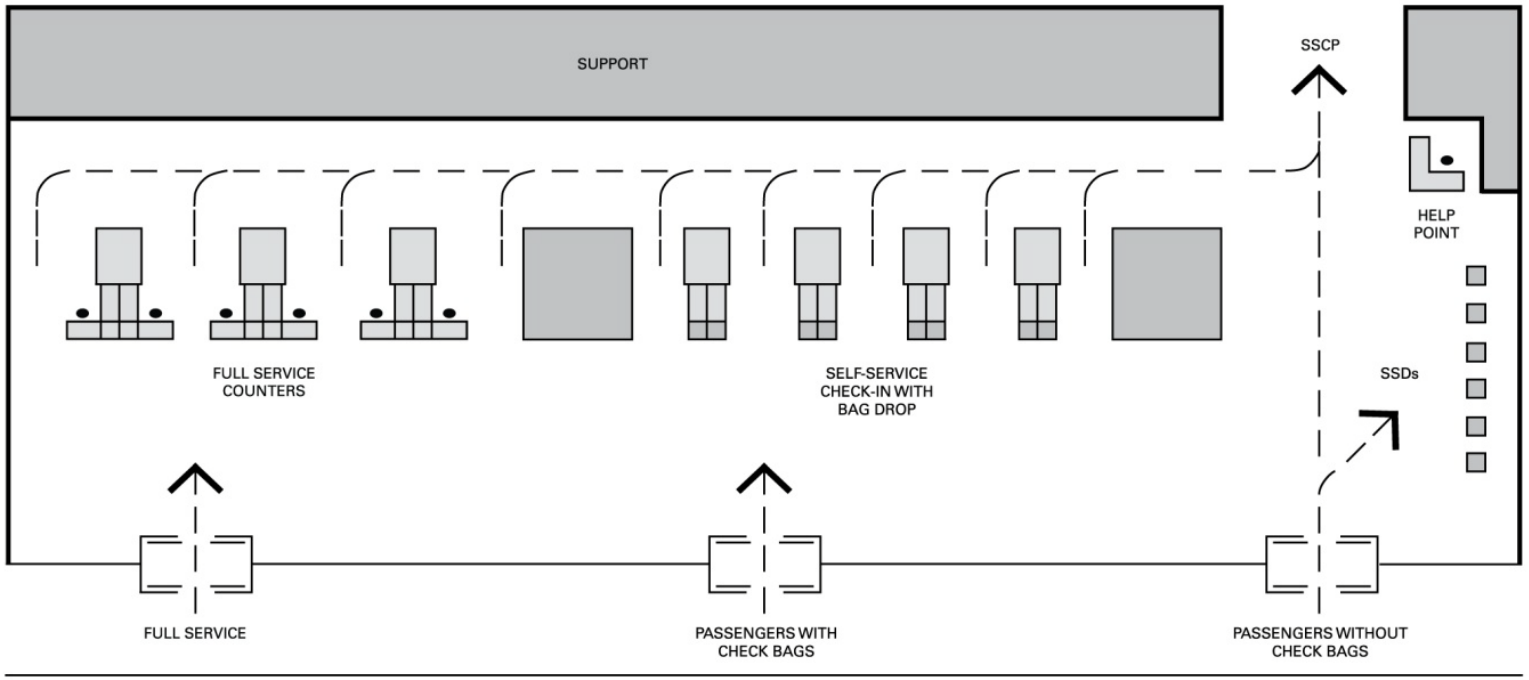
SELF-SERVICE BAG CHECK

Vienna International Airport

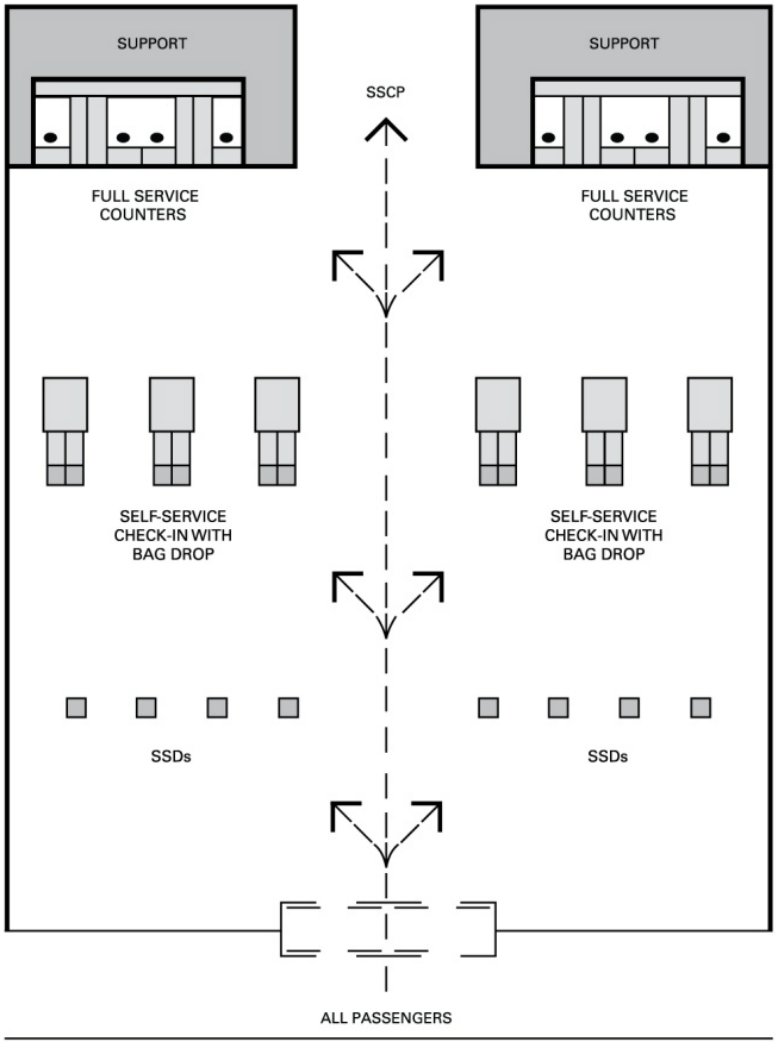
Main Street Check-in



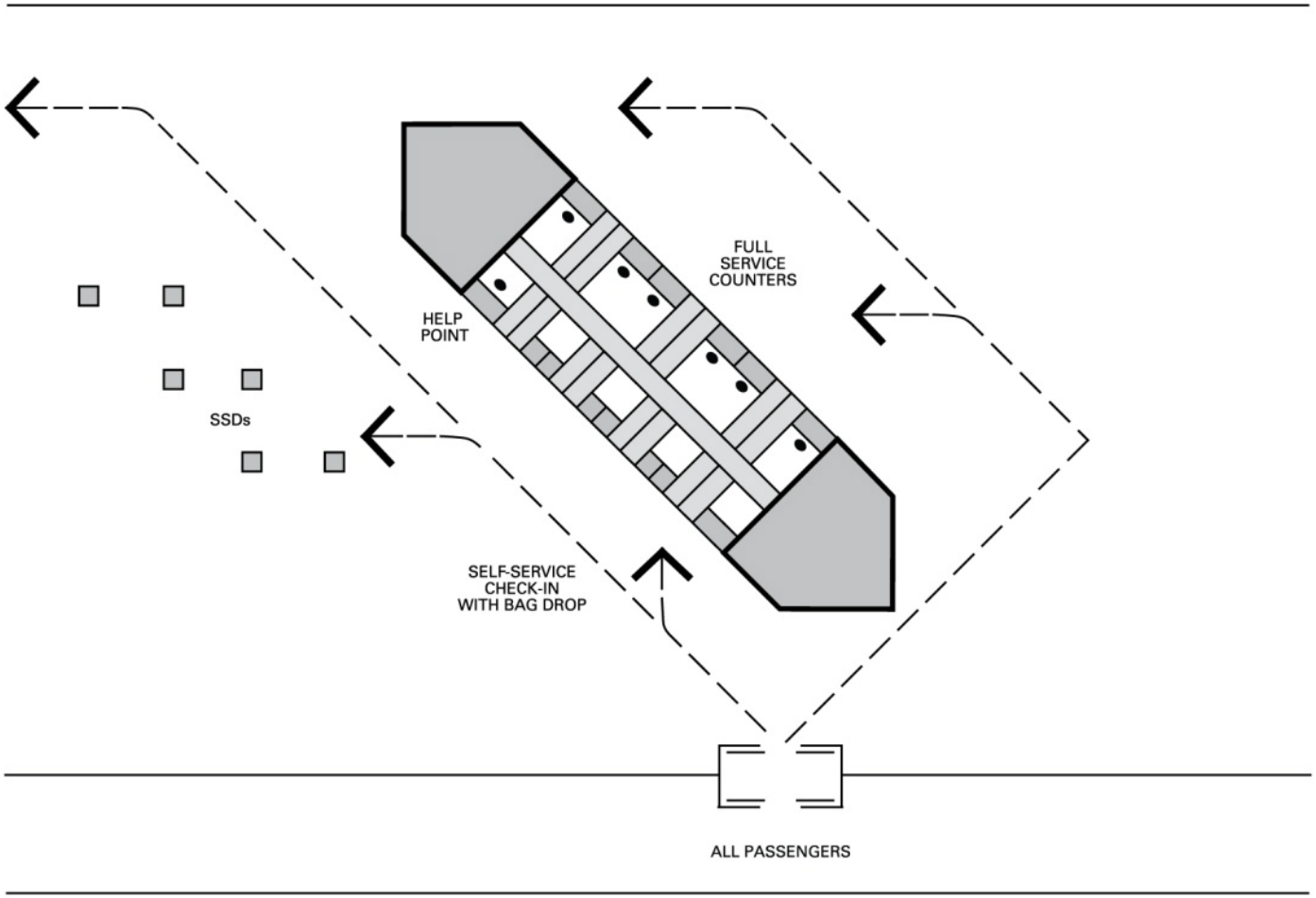
Three-lane Check-in



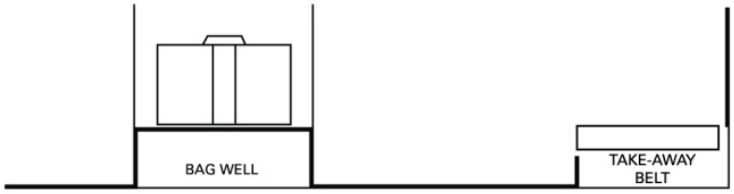
Three-stage Check-in



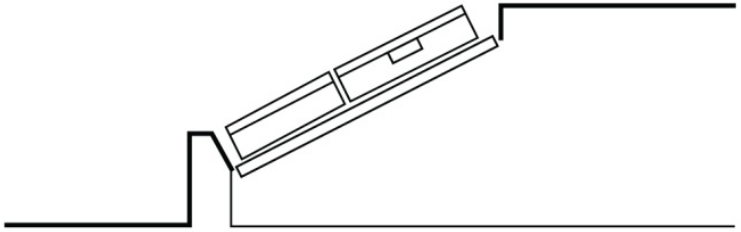
Directional Check-in



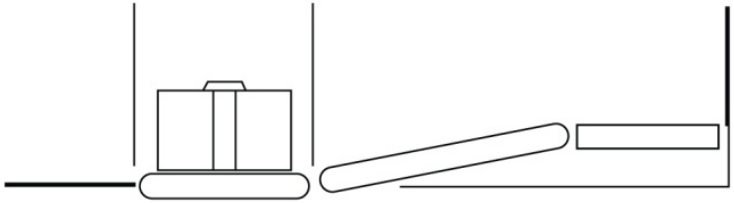
Low-profile Passenger Baggage Devices



TYPICAL ARRANGEMENT



TYPICAL CAROUSEL CLAIM



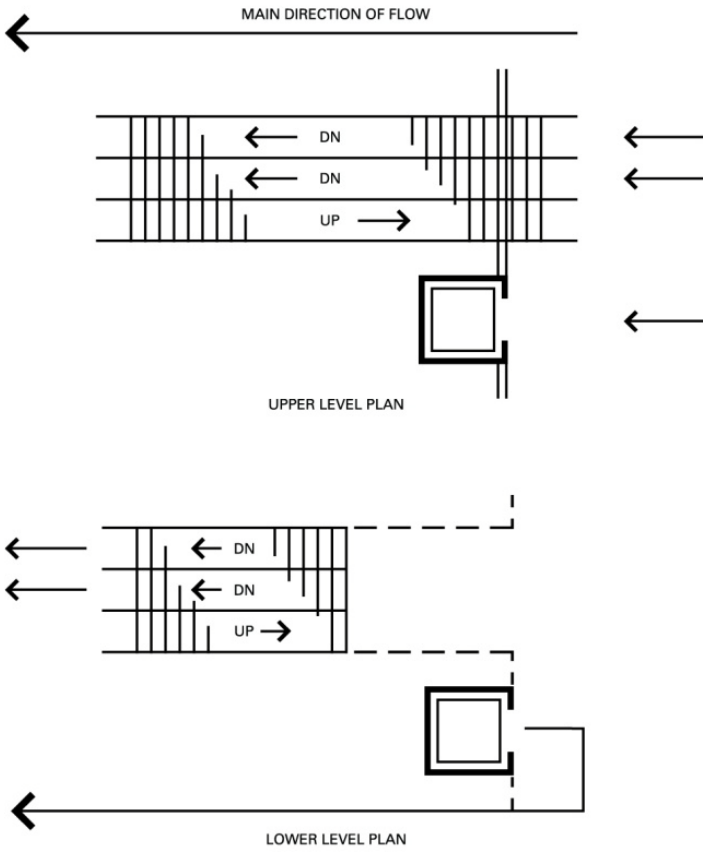
LOW PROFILE

FLAT PLATE CLAIM

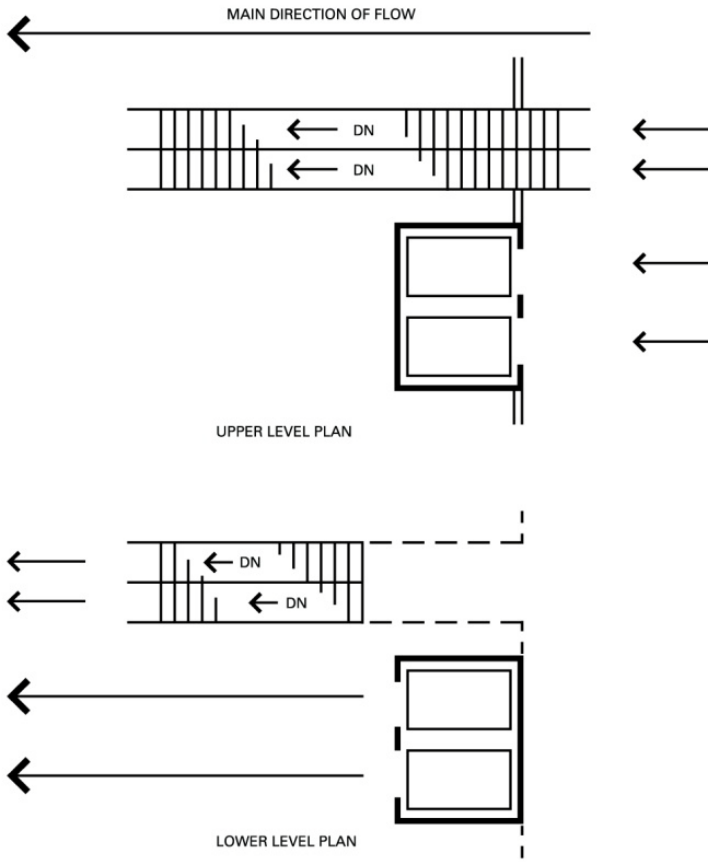
TICKET COUNTER BAG WELL

BAGGAGE CLAIM

High-capacity Flow-through Elevators



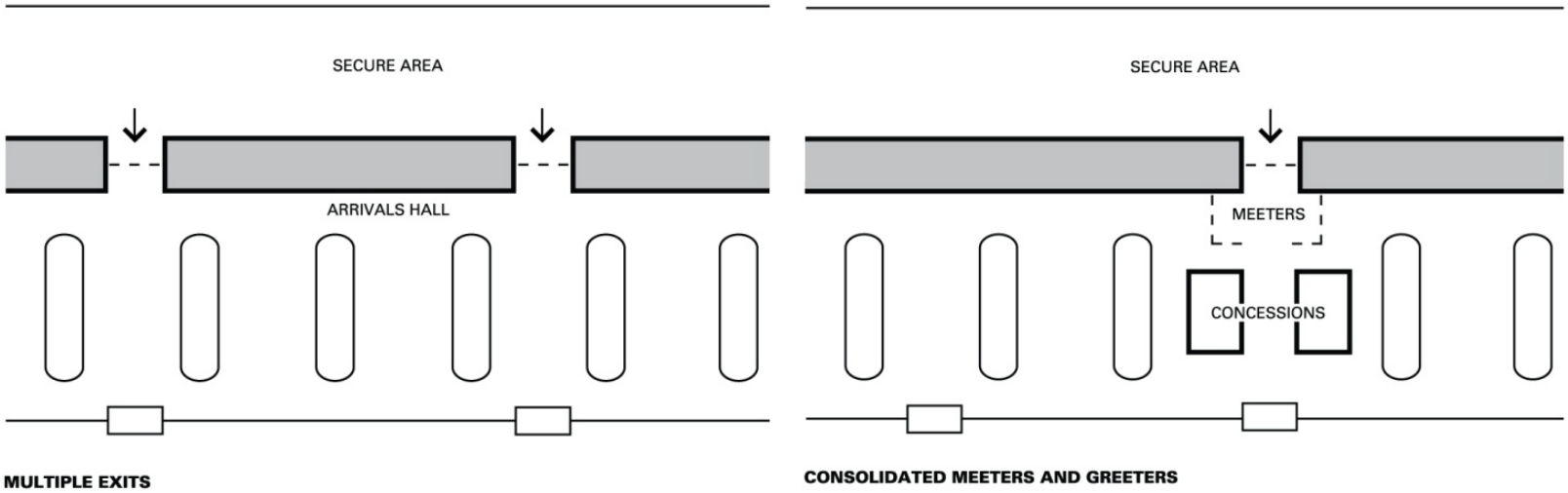
TYPICAL ARRANGEMENT



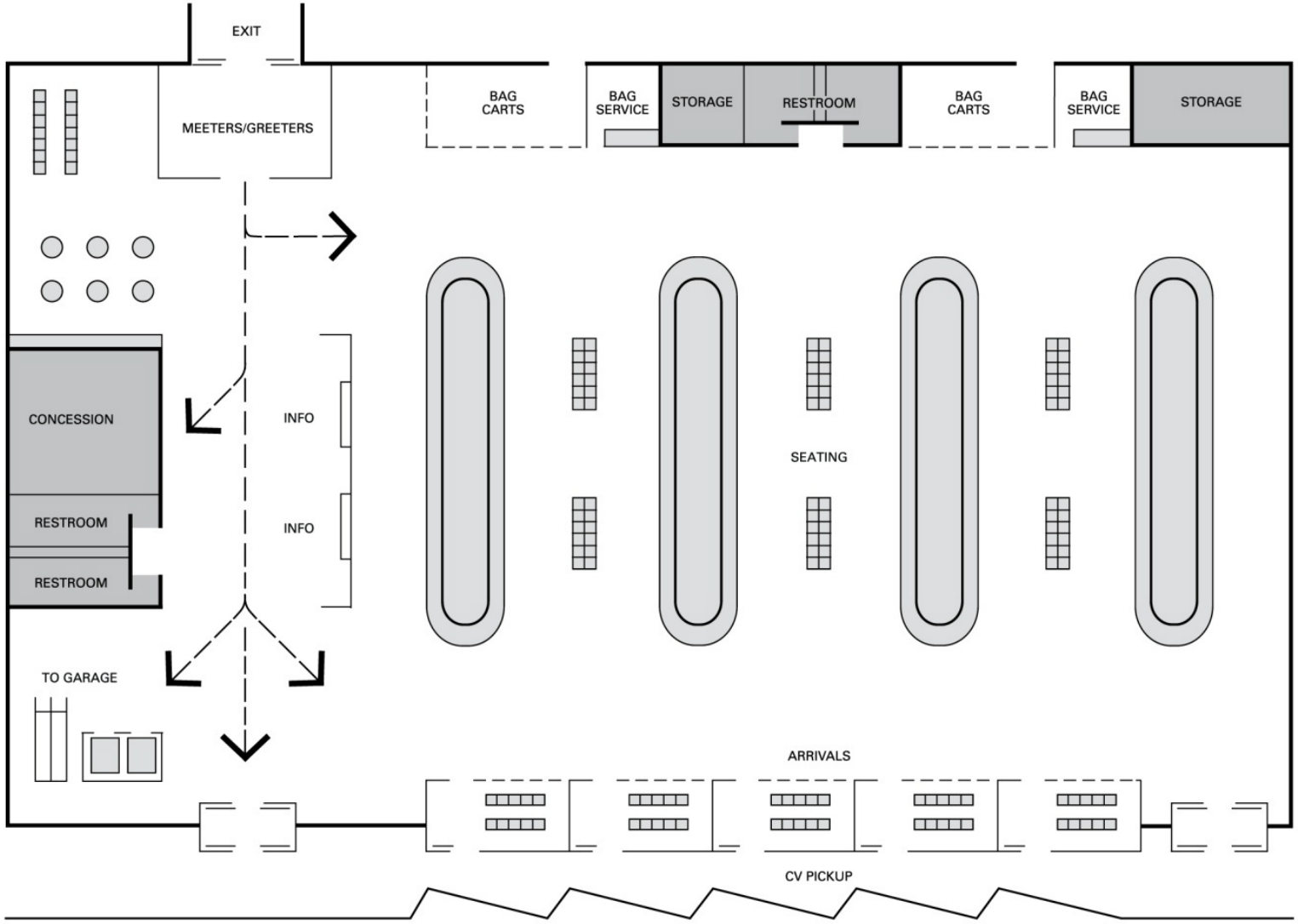
FLOW THROUGH ARRANGEMENT

Vertical Transit – Heathrow

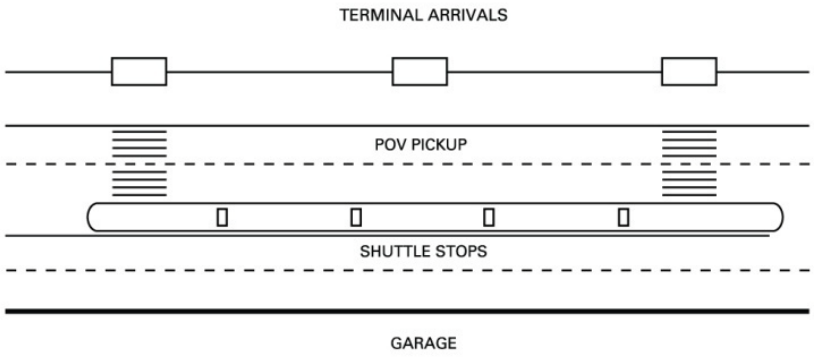
Consolidated Meeters and Greeters Area



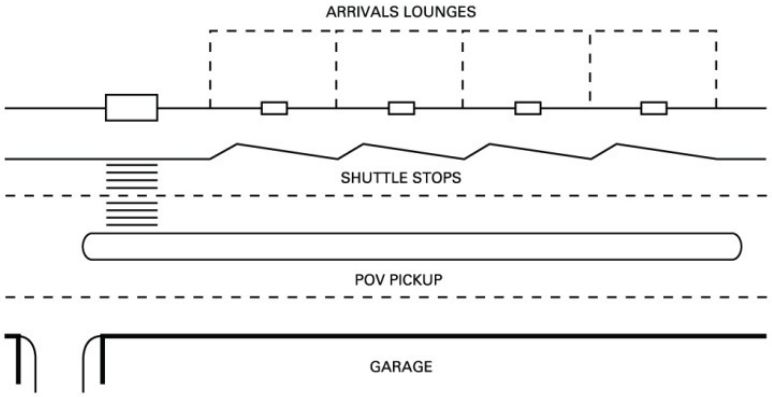
Consolidated Domestic Arrivals Hall



Arrivals Lounges

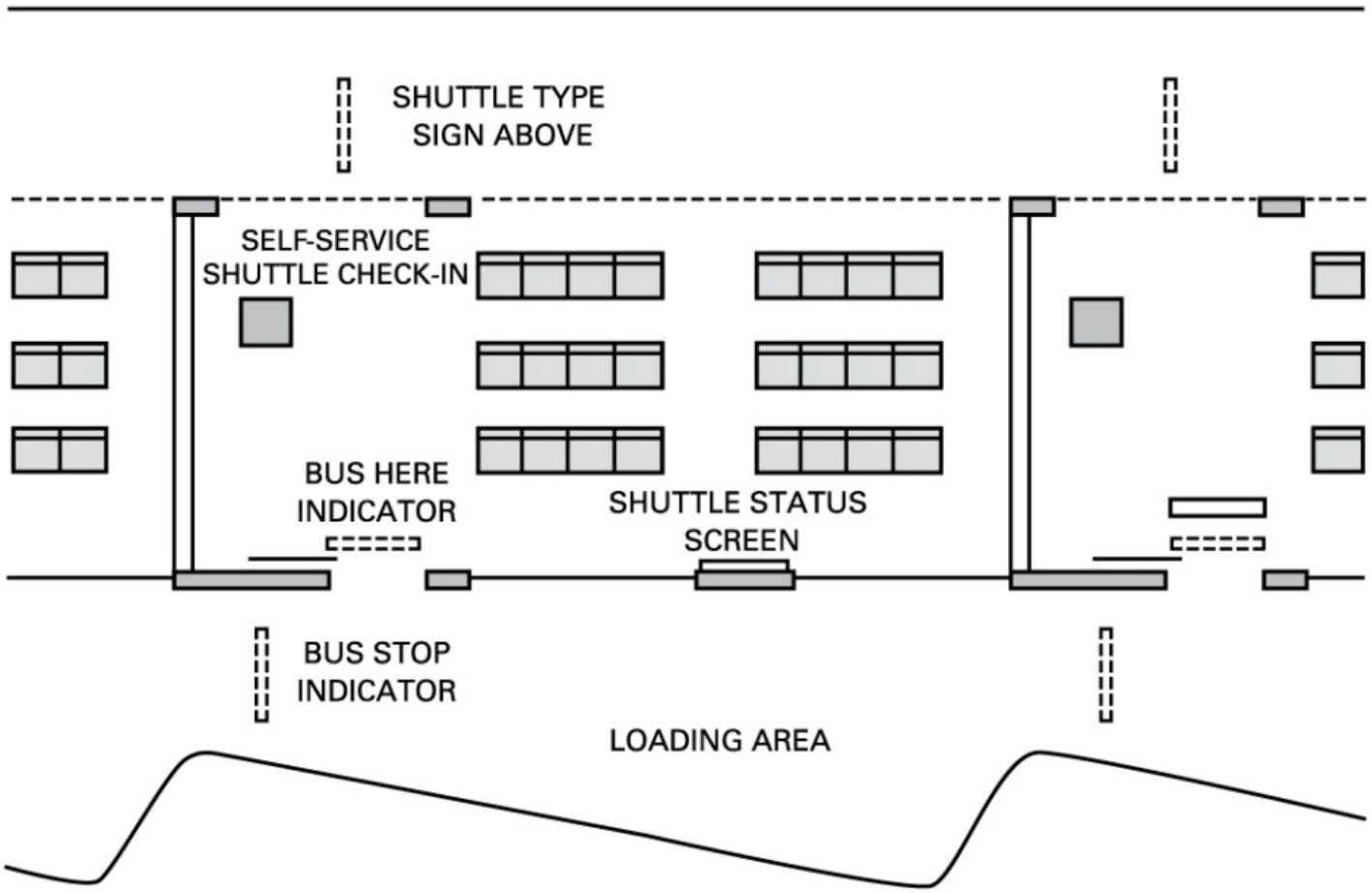


TYPICAL ARRIVALS ROADWAY



ARRIVALS LOUNGE CONCEPT

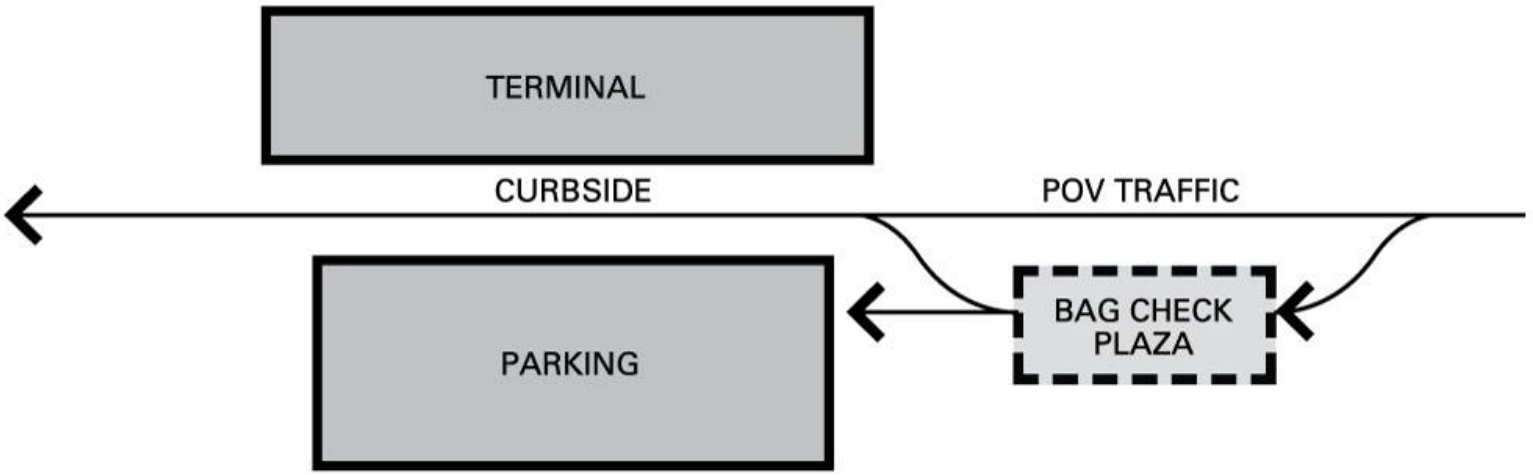
Arrivals Lounges



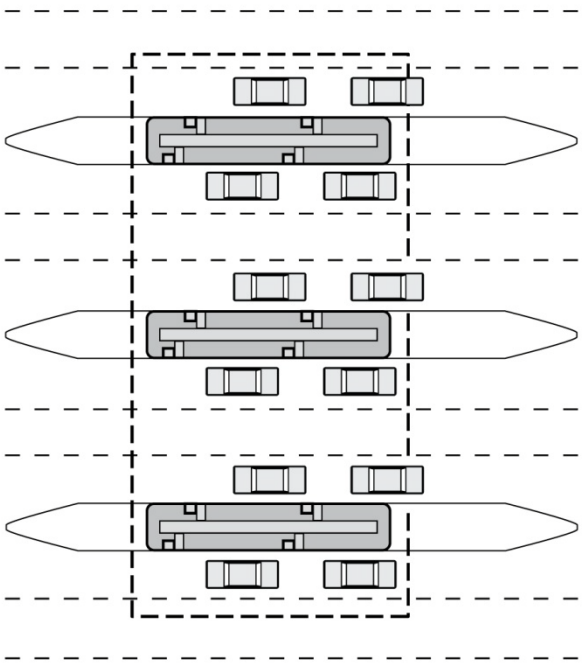
Landside Innovations

- Bag Check Plaza
- Supplemental Curbsides
- Passenger Assistance Parking Area
- Passenger Processing Facility Concepts
- Passenger Processing Facility Examples

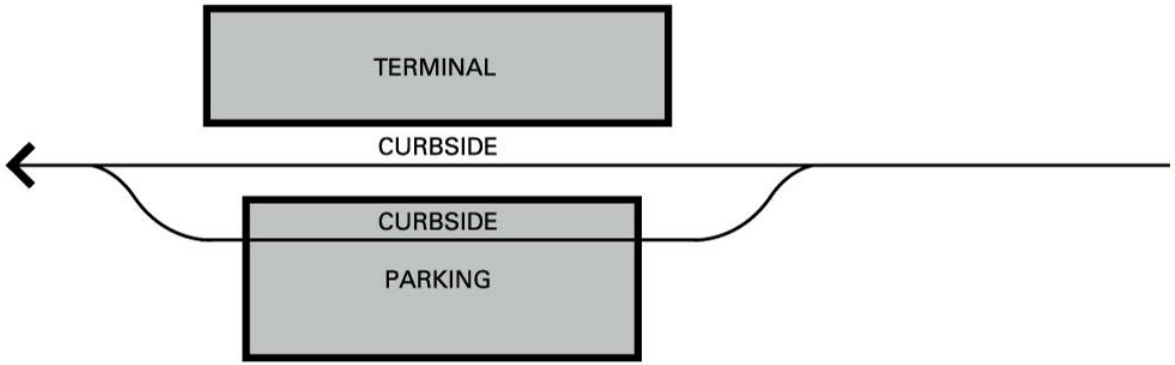
Bag Check Plaza



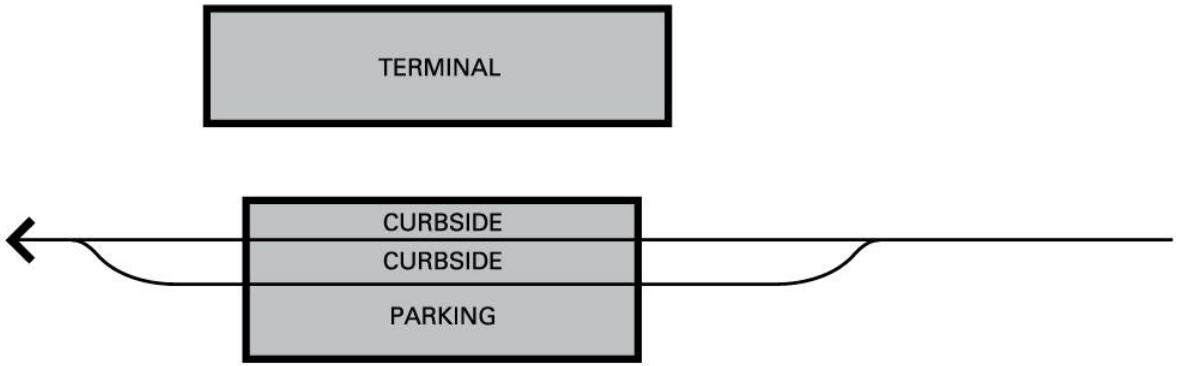
Drive Through Bag Check



Supplemental Curbsides

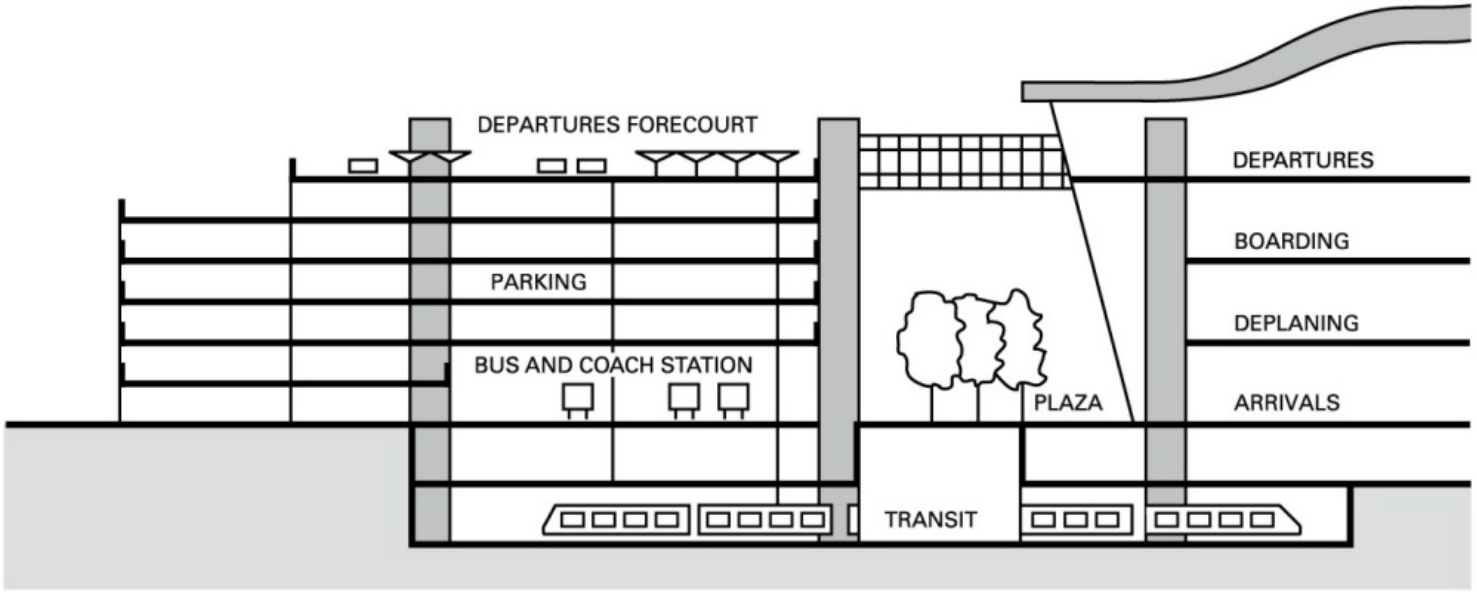


TERMINAL AND GARAGE

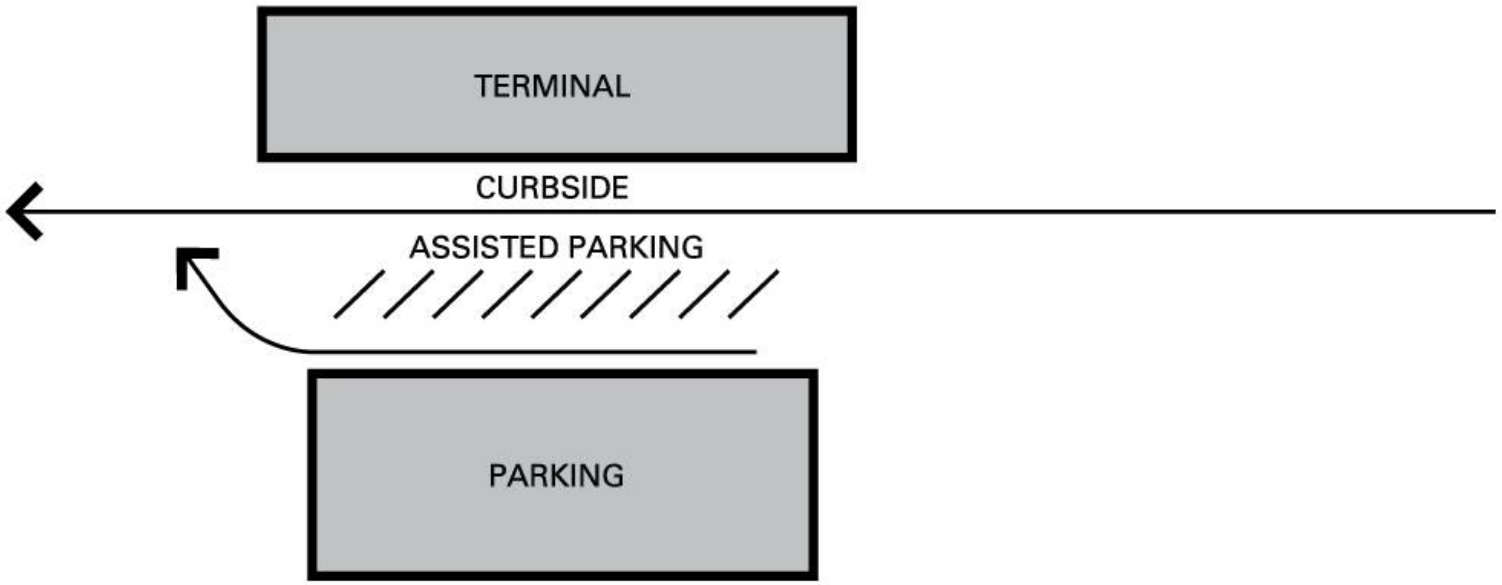


GARAGE ONLY

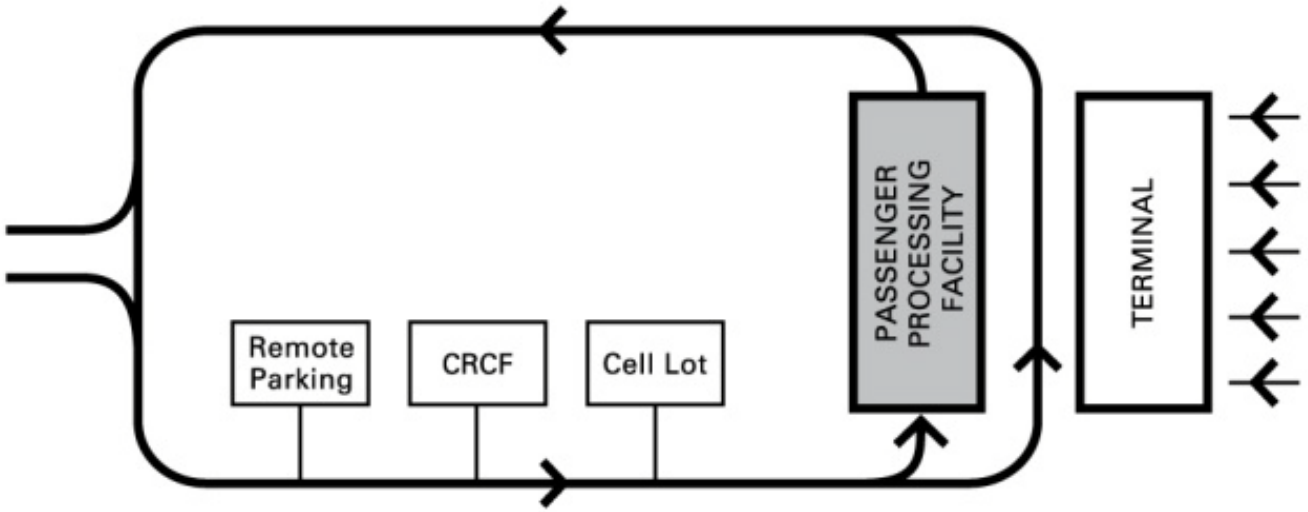
Heathrow Terminal 5



Passenger Assistance Parking Area

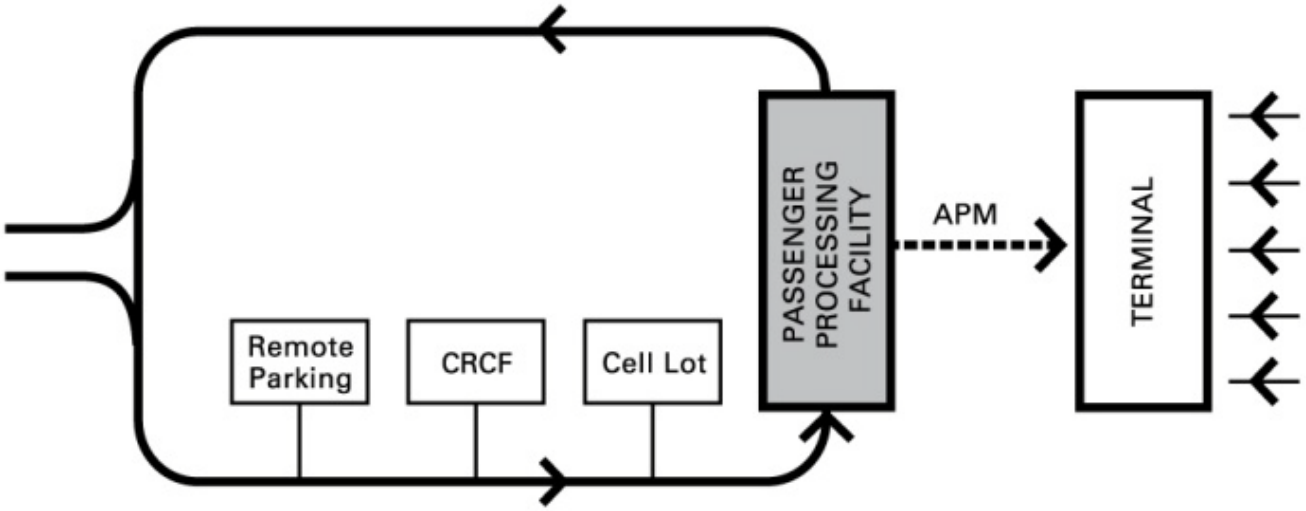


Adjacent Passenger Processing Facilities

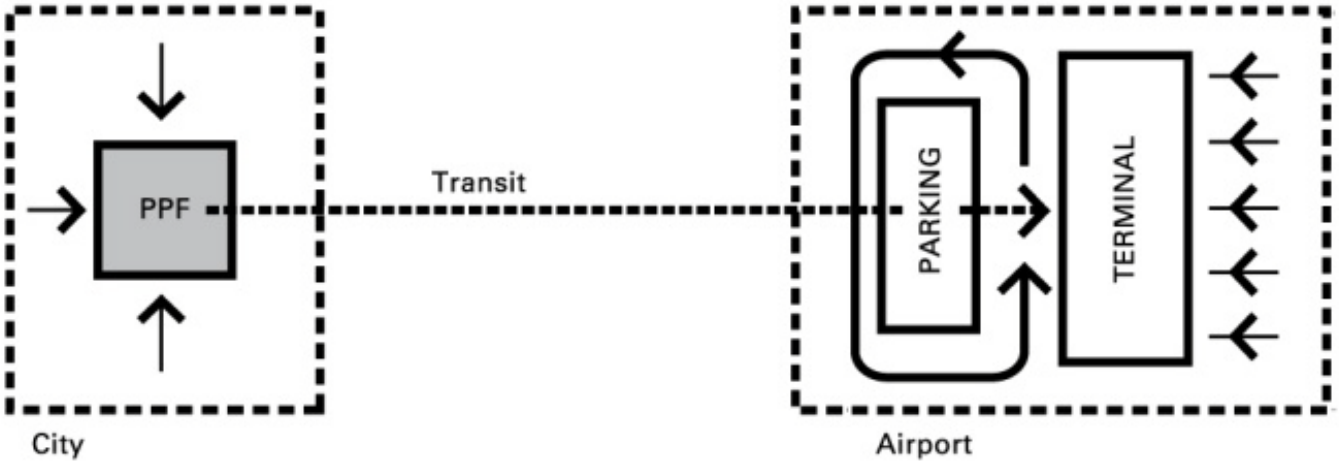


ADJACENT PASSENGER PROCESSING FACILITY

On-Airport Passenger Processing Facility

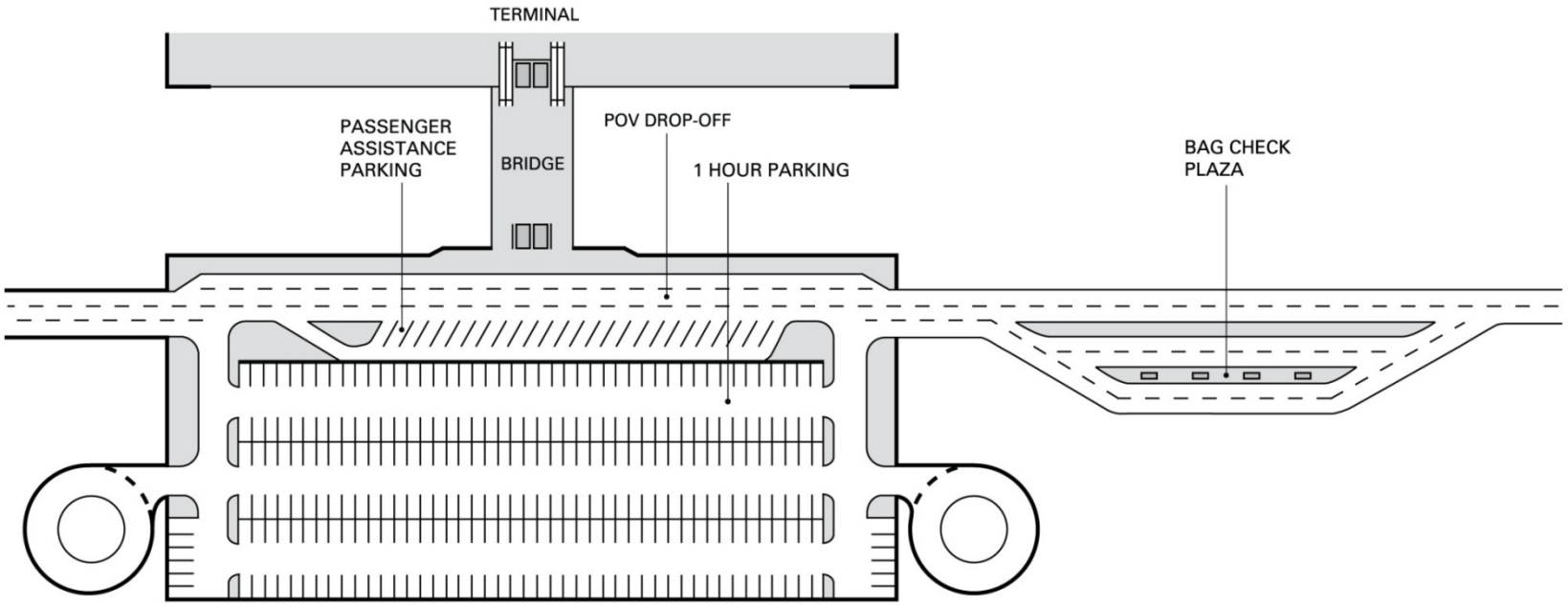


Remote Passenger Processing Facility



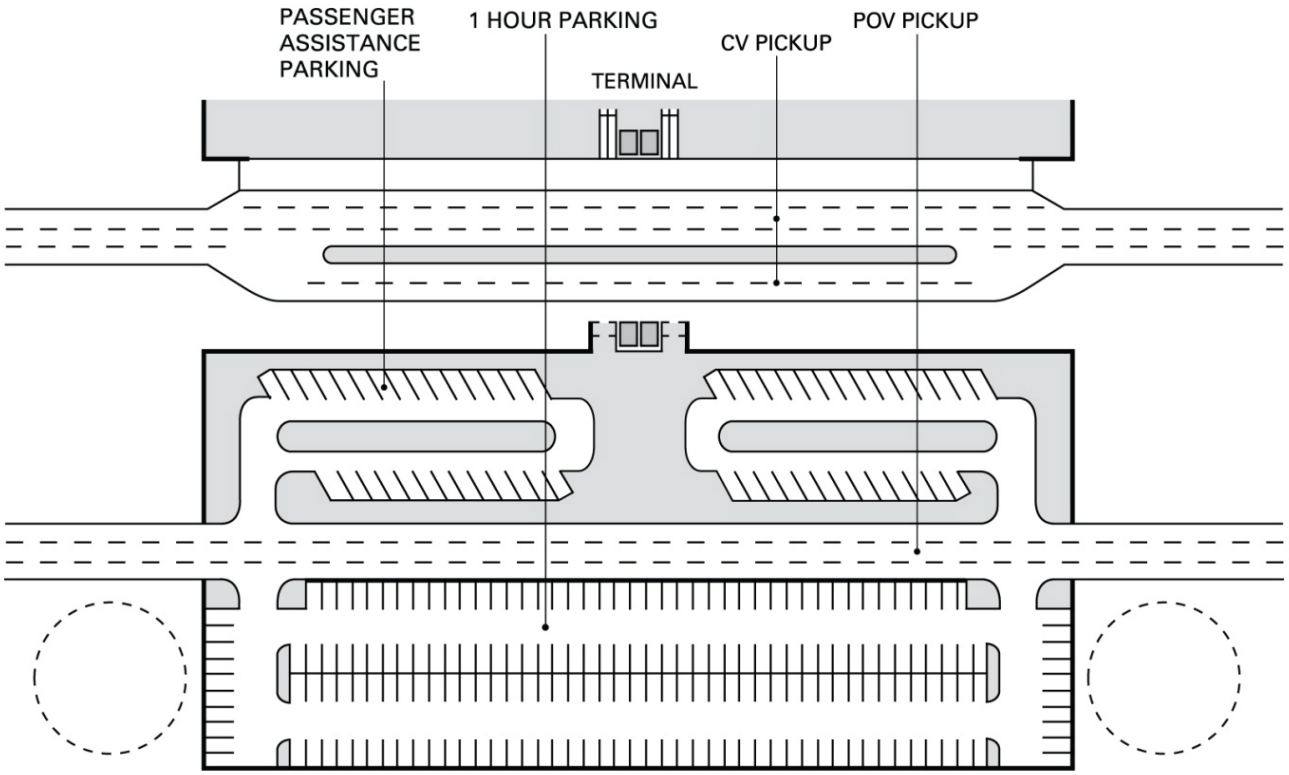
REMOTE PASSENGER PROCESSING FACILITY

APPF – Concept Example



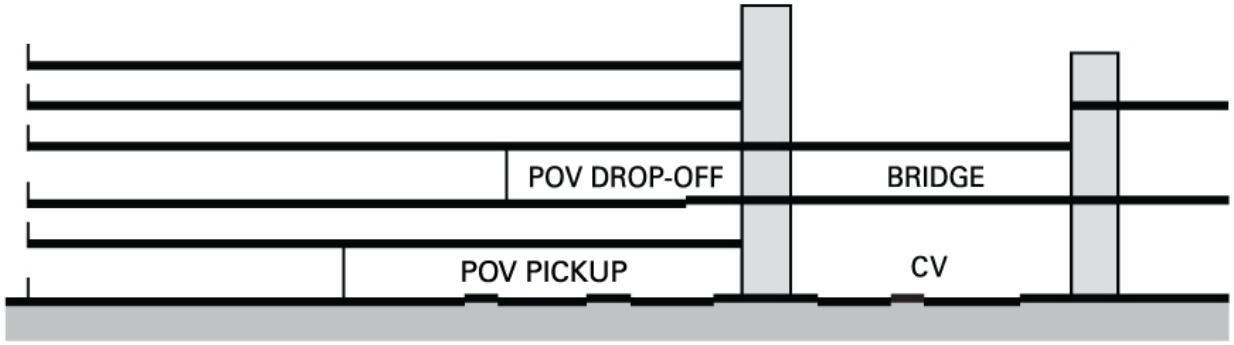
DEPARTURES LEVEL

APPF – Concept Example

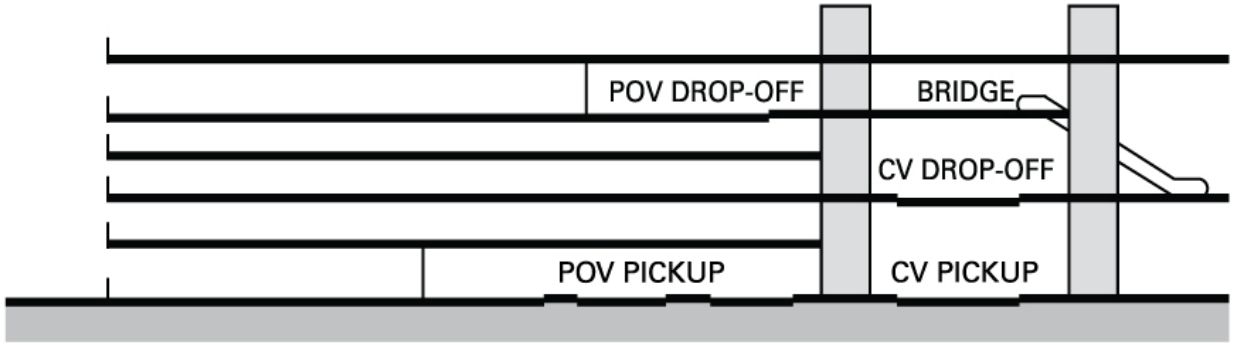


ARRIVALS LEVEL

APPF – Concept Example

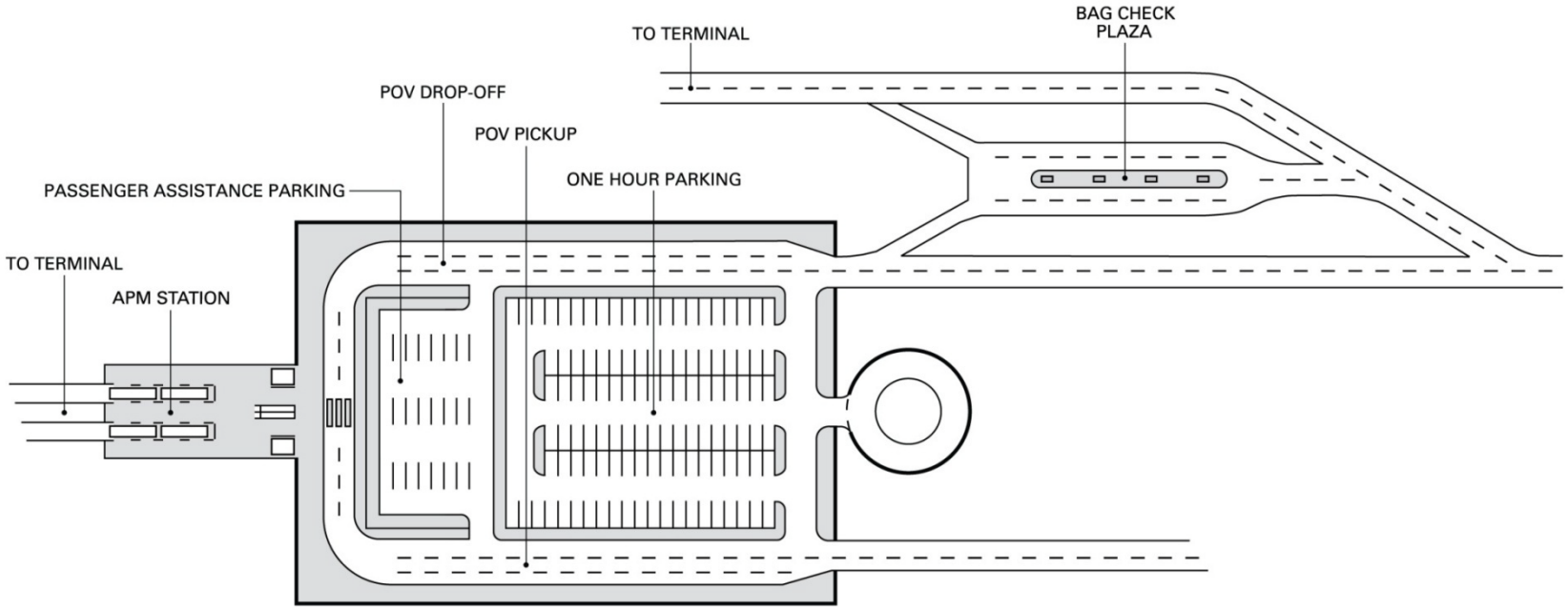


TWO LEVEL TERMINAL AND SINGLE LEVEL ROADWAY



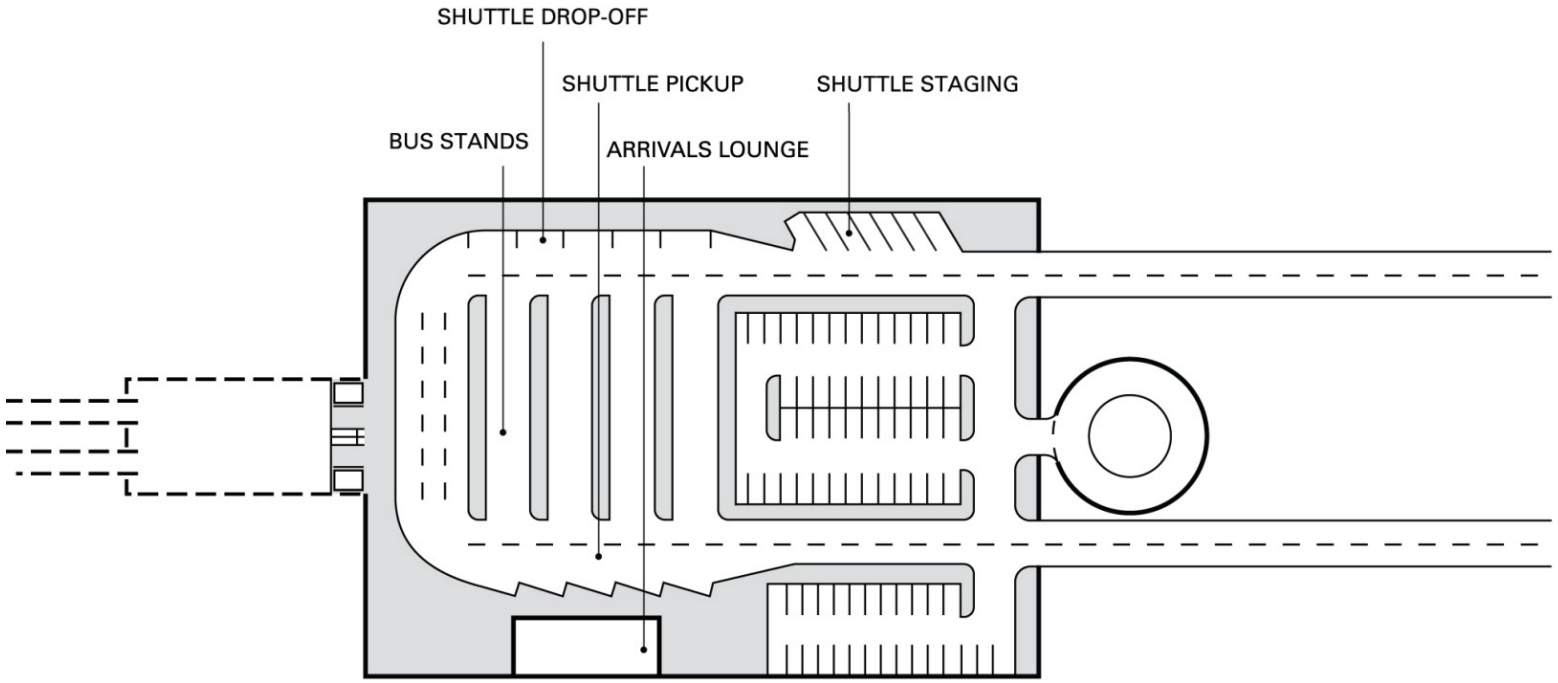
TWO LEVEL TERMINAL AND ROADWAY

OPPF – Concept Example



APM STATION LEVEL

OPPF – Concept Example



LOWER LEVEL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