

# **Defining Capacity of Airport Passenger Buildings**

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# **Defining Capacity of Airport Passenger Buildings**

- **Objective: To Present and Explain Standards for Sizing**
- **Topics**
  - **Concepts of Capacity**
  - **Design Concept**
  - **Levels of Service**
  - **IATA Space Standards (New Version in 2004!)**
  - **Dwell Time**
  - **Flow Standards**
  - **Summary**

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# Concepts of Capacity I

## 1. Static: Storage Potential of Facility

## 2. Dynamic: Ability of Facility to Process Flows

- The Central Concept for the Design of Airport Passenger Buildings
- Passengers, bags, cargo always Queue for and Move through Services (e.g.: Check-in, inspections, waiting for departures, etc.)

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# Concepts of Capacity II

## • Dynamic Capacity can be:

1. Sustained: Maximum flow over a significant period  
i.e., a morning arrival period
2. Maximum: Maximum flow for a brief period

## • Dynamic Capacity is a Variable!!! Unlike Static Capacity, of a bottle

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# Design Concept

- **From Queuing Theory recall:**  
More Space, Service => Less Delays
- **Design for Dynamic Flows is:**  
Tradeoff between Delays and Cost of Service, Space
- **Dynamic Capacity depends on:**
  - 1. Acceptable level of Delays and thus:
  - 2. Length of Period over which delays build up
- **For Short Periods, More Delays Tolerable**

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# Level of Service (LOS)

- **A verbal description of Quality of Service in terms of Ease of Flow and Delays**
- **6 categories (IATA Airport Development Man.):**

<u>LOS</u>	<u>Flows</u>	<u>Delays</u>	<u>Comfort</u>
A - Excellent	Free	None	Excellent
B - High	Stable	Very Few	High
C - Good	Stable	Acceptable	Good
D - Adequate	Unstable	Passable	Adequate
E - Inadequate	Unstable	Unacceptable	Inadequate
F - Unacceptable	--- System Breakdown ---		Unacceptable

- **System Managers should Specify LOS, e.g:**
  - Level C = standard minimum ; Level D = for crush periods

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# IATA LOS Space Standards

(old version: Airport Development Manual, 8th ed.,1995)

- Useful intro to more sophisticated new version
- In square meters per person

Area	A	B	C	D	E	F
Wait/circulate	2.7	2.3	1.9	1.5	1.0	
Bag Claim	2.0	1.8	1.6	1.4	1.2	
Check-in Queue	1.8	1.6	1.4	1.2	1.0	
Hold-room Inspection	1.4	1.2	1.0	0.8	0.6	

- More space needed for movement, with bags

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# IATA Stds: Wait / Circulate

(new version: Airport Development Manual, 9th ed., 2004)

- Old:

Square meters / Passenger for Level of Service				
A	B	C	D	E
2.7	2.3	1.9	1.5	1.0

- New:

- Distinguishes locations, likelihood of carts
- References speed

Location	Carts	Space M <sup>2</sup> /pax	Speed m / sec
Airside	None	1.5	1.3
After check-in	Few	1.8	1.1
Departure area	many	2.3	0.9

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# IATA Stds: Passport / Hold

(new version: Airport Development Manual, 9th ed., 2004)

- **Old:**

Square meters / Passenger for Level of Service				
A	B	C	D	E
1.4	1.2	1.0	0.8	0.6

- **New (for hold rooms only):**

→ Assumes 1.7 m<sup>2</sup>/pax sitting, 1.2 m<sup>2</sup>/ standee

→ LOS defined in terms of % of space used

Maximum Occupancy Rate (% of Capacity)				
A	B	C	D	E
40	50	65	80	95

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# IATA Stds: Bag Claim Area

(new version: Airport Development Manual, 9th ed., 2004)

- **Old:**

Square meters / Passenger for Level of Service				
A	B	C	D	E
2.0	1.8	1.6	1.4	1.4

- **New:**

→ Assumes 40% of Passengers use carts

→ Has a wider range: more for A, less for E

Square meters / Passenger for Level of Service				
A	B	C	D	E
2.6	2.0	1.7	1.3	1.0

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# IATA Stds: Check-in Area

(new version: Airport Development Manual, 9th ed., 2004)

- **Old:**

Square meters / Passenger for Level of Service				
A	B	C	D	E
1.8	1.6	1.4	1.2	1.0

- **New:**
  - Reflects impact of number of bags, carts

Row width	Carts bags	Square meters / Passenger for Level of Service				
		A	B	C	D	E
1.2m	few	1.7	1.4	1.2	1.1	0.9
	more	1.8	1.5	1.3	1.2	1.1
1.4 m	high	2.3	1.9	1.7	1.6	1.5
	heavy	2.6	2.3	2.0	1.9	1.8

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## Snake Line at LOS = C



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## Snake line at LOS = E



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## Note: Kiosks change process

- **Kiosks = automated check-in machines => CUSS (Common Use Self Service) if common**
- **Speeds up check-in**
  - Automated data entry (try “de Neufville”)
- **Less Staff, Less counter Space**
  - => Old layouts obsolete see Boston Internatl. Bldg
- **Disperses Queues**
  - Latest standards do not apply easily...
- **CUSS at Las Vegas, Tokyo, in Canada**

# Dwell Time

- **Determines Capacity of any space or process**
- **A Central Concept: Source of Major Problems**
- **It is the Average Time a person is in a space or process**
- **When a person leaves a space, Replacement can use it**
- **As people move faster**
  - Dwell time is shorter
  - More replacements can use space in any period

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# Formula for Space Required

- **Space Required, sq. meters =**  
(Load, pers./hour) (Std, sq.m./person) (Dwell time, hours)  
= (Persons/Time) (Area/Person) (Time) = Area
- **Example:**  
*What space is required for passport inspection of 2000 passengers per hour when maximum wait is 20 minutes?*  
**Space Needed = 2000 (1) (1/3) = 667 sq. m.**

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# Formula for Capacity of a Space

- **Load, persons per hour =**  
(Space, sq. m.) / (Std, sq. m. per pers)(Dwell time, hrs)

- **Examples:**

- What is the recommended load (LOS =C) for a 30m. by 50m. waiting room, in which transit passengers average 90 minutes?

Recommended load = (30) (50) / (1.9) (1.5) = 1500 / 2.85 = 527

- What is the crush capacity of the same space?

Crush load = (30) (50) / (1.5) (1.5) = 667 pers. per hr.

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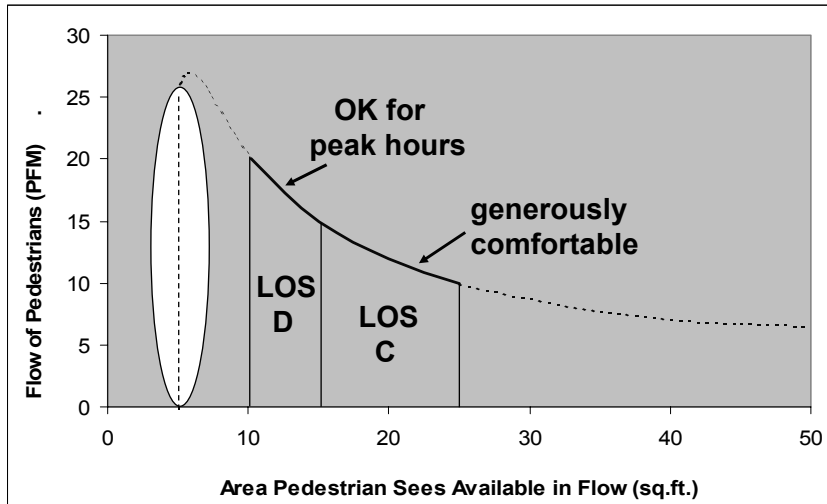
# Flow Standards

**In terms of PMM = Persons/Minute/Meter**

Type of Passageway	Level of Service Standard					
	A	B	C	D	E	F
Corridor	10	12.5	20	28	37	More
Stairs	8	10	12.5	20	20	More

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# Level of Service Diagram for Passenger Flows



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## Assumptions of Flow Standards

- **Two Factors**

- 1. Space per Person  
e.g.: 1.9 sq. m. per person for LOS = C
- 2. Walking Speed  
e.g.: 66 meters/min = 4 km/hour  
=> Low Dwell Time  
=> High Capacity

- **Example:**

Capacity of Corridor, 5m. wide, 40m. long

Dwell time =  $40 / 4000 = 0.01$  hour

Recommended Load, persons per hour

=  $(5) (20) / (1.9) (0.01) = 5,000$

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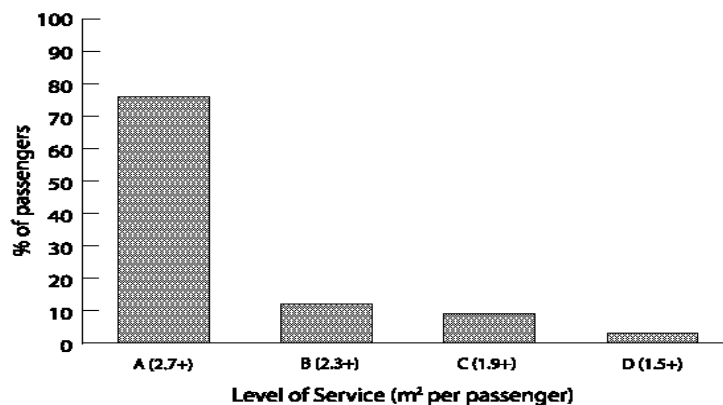
## Formula for Flow Areas

- **Total Corridor Width Needed, meters = Effective Width + 1.5m. for edge effects**
- **Eff. width = (Persons /Minute) / (PMM)**
- **Example:** *What is recommended width of corridor to handle 600 persons per quarter hour, in both directions?*  
Effective width =  $600 / 20 = 4.0\text{m}$   
Required width =  $4.0 + 1.5 = 5.5\text{m}$
- **Note: Corridor capacity is very great!**  
→ Most corridors > need ; Architectural considerations dominate

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## LOS varies over day, year!

- **Example Distribution from Toronto**



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# Summary

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- **Key concepts about capacity:**

- 1. Not purely technical issue
- 2. Management decision about tradeoffs Cost vs. LOS
- 3. Financial and Service Objectives of Airport critical

- **Key technical details:**

- 1. Dwell time critical factor
- 2. Through flows slash dwell time
- 3. Capacity of corridors enormous