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**

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.)**

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

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 OK**

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.):**

LOS	Flows	Delays	Comfort
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**

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**

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^2/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

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^2/pax sitting, 1.2 m^2/ standee**
  - **LOS defined in terms of % of space used**

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

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

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

Snake Line at LOS = C

Snake line at LOS = E

Note: Kiosks change process

- Kiosks = automated check-in machines => CUSS (Common Use Self Service) if common
- Speeds up check-in
  - Automated data entry (try to enter “de Neufville”)
- Less Staff, Less counter Space
  - Old layouts obsolete: e.g., 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**

- **Is Average Time a body 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**

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.

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 waiting room 30x50m, 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?**

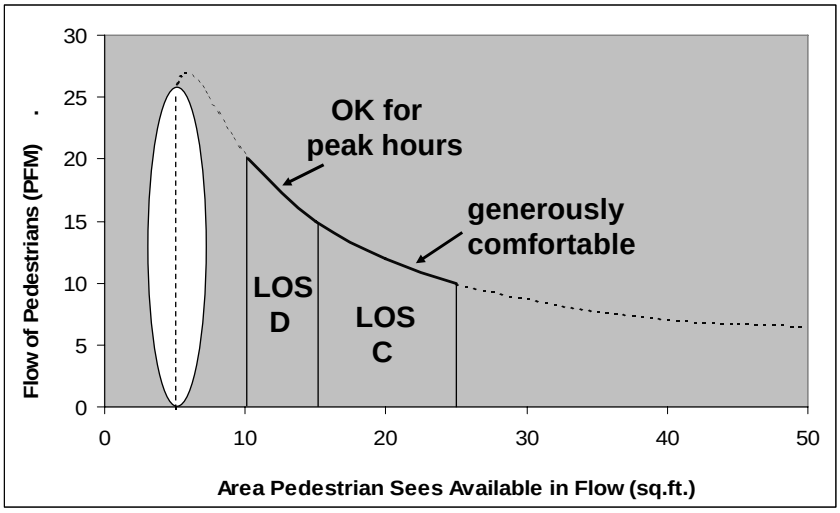
Crush load = (30) (50) / (1.5) (1.5) = 667 pers. per hr.

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

Level of Service Diagram for Passenger Flows



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

Formula for Flow Areas

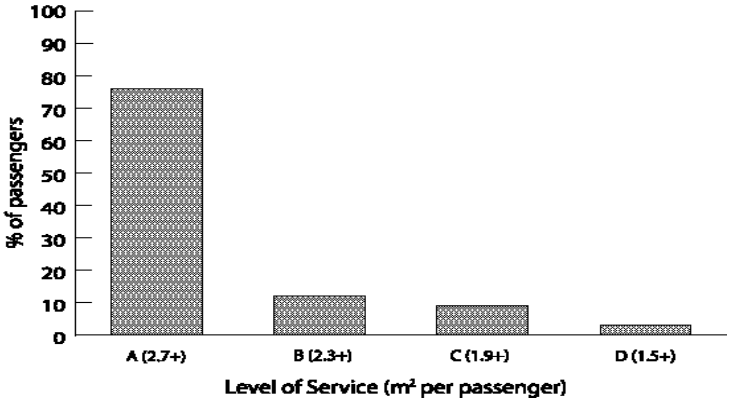
- **Total Corridor Width Needed, meters = Effective Width + 1.5m. for edge effects**
- **Eff. width = (Persons /Minute) / (PMM)**
- **Example:** *What is recommended width of corridor to handle 600 persons per quarter hour, in both directions?*

  Effective width = 80 / 20 = 4.0m
  Required width = 4.0 + 1.5 = 5.5m

- **Note: Corridor capacity is very great!**
  - ✈ **Most corridors > need ; Architectural considerations dominate**

LOS varies over day, year!

- **Example Distribution from Toronto**



Summary

- **Key concepts about capacity:**
  - **1. Not purely technical issue**
  - **2. Management decision about tradeoffs**
    Cost vs. LOS
  - **3. Financial and Service Objectives are critical**

- **Key technical details:**
  - **1. Dwell time critical factor**
  - **2. Through flows slash dwell time**
  - **3. Capacity of corridors enormous**