Defining Capacity of Airport Passenger Buildings

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Objective: To Present and Explain Standards for Sizing

Topics
- Concepts of Capacity
- Design Concept
- Levels of Service
- IATA Space Standards
- 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 $\Rightarrow$ 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

Level of Service (LOS)

- A verbal description of Quality of Service in terms of Ease of Flow and Delays

- Six standard categories:

<table>
<thead>
<tr>
<th>LOS</th>
<th>Flows</th>
<th>Delays</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Excellent</td>
<td>Free</td>
<td>None</td>
</tr>
<tr>
<td>B - High</td>
<td>Stable</td>
<td>Very Few</td>
</tr>
<tr>
<td>C - Good</td>
<td>Stable</td>
<td>Acceptable</td>
</tr>
<tr>
<td>D - Adequate</td>
<td>Unstable</td>
<td>Passable</td>
</tr>
<tr>
<td>E - Inadequate</td>
<td>Unstable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>F - Unacceptable</td>
<td>--- System Breakdown ---</td>
<td></td>
</tr>
</tbody>
</table>

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

- In square meters per person

<table>
<thead>
<tr>
<th>Area</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait/circulate</td>
<td>2.7</td>
<td>2.3</td>
<td>1.9</td>
<td>1.5</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Bag Claim</td>
<td>2.0</td>
<td>1.8</td>
<td>1.6</td>
<td>1.4</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Check-in Queue</td>
<td>1.8</td>
<td>1.6</td>
<td>1.4</td>
<td>1.2</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Hold-room</td>
<td>1.4</td>
<td>1.2</td>
<td>1.0</td>
<td>0.8</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Inspection</td>
<td>1.4</td>
<td>1.2</td>
<td>1.0</td>
<td>0.8</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>

- More space needed for movement, with bags


Snake Line at LOS = C
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
Formula for Space Required

- Space Required, sq. meters =
  \[(\text{Load, pers./hour}) \times (\text{Std, sq.m./person}) \times (\text{Dwell time, hours})\]
  \[= (\text{Persons/Time}) \times (\text{Area/Person}) \times (\text{Time}) = \text{Area}\]

- Example:
  What space is required for passport inspection of 2000 passengers per hour when maximum wait is 20 minutes?

  Space Needed = 2000 \times (1) \times (1/3) = 667 \text{ sq. m.}

Formula for Capacity of a Space

- Load, persons per hour =
  \[(\text{Space, sq. m.}) / (\text{Std, sq. m. per pers})(\text{Dwell time, hrs})\]

- 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) \times (50) / (1.9) \times (1.5) = 1500 / 2.85 = 527
  - What is the crush capacity of the same space?
    Crush load = (30) \times (50) / (1.5) \times (1.5) = 667 \text{ pers. per hr.}
Flow Standards

In terms of PMM = Persons/Minute/Meter

<table>
<thead>
<tr>
<th>Type of Passageway</th>
<th>Level of Service Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Corridor</td>
<td>10</td>
</tr>
<tr>
<td>Stairs</td>
<td>8</td>
</tr>
</tbody>
</table>

Level of Service Diagram for Passenger Flows

Area Pedestrian Sees Available in Flow (sq. ft.)

Flow of Pedestrians (PFM)

OK for peak hours

generously comfortable

Los D

Los C
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 of Airport critical

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