Planning and Design of the Terminal Area

The terminal area is the major interface between the airfield and the rest of the airport. It includes the facilities for passenger and baggage processing, cargo handling, and airport maintenance, operations, and administration activities.
The passenger terminal system is the major connection between the ground access system and the aircraft.

The purpose of this system is to provide the interface between the passenger airport access mode, to process the passenger for origination, termination, or continuation of an air transportation trip, and convey the passenger and baggage to and from the aircraft.
Components of the System
The passenger terminal system is composed of three major components. These components and the activities that occur within them are as follows:

1. The access interface where the passenger transfers from the access mode of travel to the passenger processing component. Circulation, parking, and curbside loading and unloading of passengers are the activities that take place within this component.

2. The processing component where the passenger is processed in preparation for starting, ending, or continuation of an air transportation trip.

3. The flight interface where the passenger transfers from the processing component to the aircraft.
The Passenger Terminal System

Figure 10-2 Components of the passenger terminal system.
The Passenger Terminal System

Design Considerations:
1. Development and sizing to accomplish the stated mission of the airport within the parameters defined in the master plan
2. Capability to meet the demands for the medium- and long run time frames
3. Functional, practical, and financial feasibility
4. Maximize the use of existing facilities
5. Achievement of a balanced flow between access, terminal, and airfield facilities during the peak hour
6. Consideration of environmental sensitivity
7. Maintenance of the flexibility to meet future requirements beyond the current planning horizon
8. Capability to anticipate and implement significant improvements in aviation technology
The Passenger Terminal System
The Passenger Terminal System
Overall Space Approximations:

The FAA has indicated that gross terminal area space requirements of between 0.08 and 0.12 ft\(^2\) per annual enplaned passenger are reasonable. Another estimate is obtained by applying a ratio of 150 ft\(^2\) per design hour passenger.

An approximate breakdown of these space allocations typically is 35 to 40 percent for airline operations, 15 to 25 percent for concessions and airport administration, 25 to 35 percent for public space, and 10 to 15 percent for utilities, shops, tunnels, and stairways.
The Passenger Terminal System

<table>
<thead>
<tr>
<th>Component</th>
<th>Space Required In 1000 ft² or 100 m² per 100 Typical Peak Hour Passengers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ticket lobby</td>
<td>1.0</td>
</tr>
<tr>
<td>Baggage claim</td>
<td>1.0</td>
</tr>
<tr>
<td>Departure lounge</td>
<td>2.0</td>
</tr>
<tr>
<td>Waiting rooms</td>
<td>1.5</td>
</tr>
<tr>
<td>Immigration</td>
<td>1.0</td>
</tr>
<tr>
<td>Customs</td>
<td>3.0</td>
</tr>
<tr>
<td>Amenities</td>
<td>2.0</td>
</tr>
<tr>
<td>Airline operations</td>
<td>5.0</td>
</tr>
<tr>
<td>Total gross area</td>
<td></td>
</tr>
<tr>
<td>Domestic</td>
<td>25.0</td>
</tr>
<tr>
<td>International</td>
<td>30.0</td>
</tr>
</tbody>
</table>

**Table 10-2** Typical Terminal Building Space Requirements
The Passenger Terminal System

**Figure 10-8** Gross terminal area estimates for intermediate range planning (Federal Aviation Administration [49]).
The Terminal Planning Process

In the programming and concept development phases of a terminal design project, the following evaluation criteria are typically used to weigh alternatives:

1. Ability to handle expected demand
2. Compatibility with expected aircraft types
3. Flexibility for growth and response to technology changes
4. Compatibility with the total airport master plan
5. Compatibility with on-airport and adjacent land uses
6. Simplicity of passenger orientation and processing
7. Analyses of aircraft maneuvering routes and potential conflicts on the taxiway system and in the apron area
8. Potential for aircraft, passenger, and vehicle delay
9. Financial and economic feasibility
Figure 10-10  Public automobile parking space requirements (Federal Aviation Administration [49]).
The Passenger Terminal System
Departure Lounge

Figure 10-13  Departure lounge layout (Federal Aviation Administration [50]).
The Passenger Terminal System
Departure Lounge Area

**Cumulative Flow (Pax)**

- **F(t)**: Flow into Lounge
- **G(t)**: Flow into Airplane
- **Q(t)**: Pax in Lounge = F(t) – G(t)

**Max**

- **t_{arrival}**: Time of arrival
- **t_{b}**: Time of departure
- **t_{departure}**: Time of departure

- If **t_{i} < t_{b}**, then **G(t) = 0**
- If **t_{b} < t_{i} < t_{dep}**, then **G(t) = (t_{i} - t_{b}) \times b**
  - **b** is enplaning rate (Pax/min)
  - Assume **b = 14** Pax/min

Deplaning rate = 36 Pax/min
The Passenger Terminal System
Horizontal Distribution Concepts

The following terminal concepts should be considered in the development of the terminal area plan:

**Pier or Finger Concept:**

The pier concept has an interface with aircraft along piers extending from the main terminal area. Aircraft are usually arranged around the axis of the pier in a parallel or nose-in parking alignment. Each pier has a row of aircraft gate positions on both sides.

**Advantages:**
- allows for the expansion of the pier to provide additional aircraft parking positions without the expansion of other components
- Good capacity with relatively economical cost in terms of capital and operating cost

**Disadvantages:**
- Conflict between A/C during taxiing.
- relatively long walking distance from curb front to aircraft and the lack of a direct curb front relationship to aircraft gate positions
The following terminal concepts should be considered in the development of the terminal area plan:

**Satellite Concept:**

The satellite concept consists of a building, surrounded by aircraft, which is separated from the terminal and is usually reached by means of a surface, underground, or above ground connector. The aircraft are normally parked in radial or parallel positions around the satellite.

**Advantages:**
- Adaptability to common departure lounge and check-in functions
- The ease of aircraft maneuverability around the satellite structure

**Disadvantages:**
- Construction cost is relatively high due to the need to provide connecting concourses to the satellite.
- It lacks flexibility for expansion and passenger walking distances are relatively long.
The following terminal concepts should be considered in the development of the terminal area plan:

**Linear, Frontal or Gate Arrivals Concept:**

The simple linear terminal consists of a common waiting and ticketing area with exits leading to the aircraft parking apron.

**Advantages:**
- Provide easy and direct access from curb front to aircraft gate positions
- Gives a high degree of flexibility for expansion

**Disadvantages:**
- It does not provide convenient opportunities for the use of common facilities and.
- As this concept is expanded into separate buildings, it may lead to high operating costs
Transporter, Open Apron or Mobile Conveyance Concept:

Aircraft and aircraft servicing functions in the transporter concept are remotely located from the terminal. The connection to the terminal is provided by vehicular transport for enplaning and deplaning passengers.

Advantages:

- Flexibility in providing additional aircraft parking positions to accommodate increases in schedules or aircraft size
- The capability to maneuver an aircraft in and out of a parking position under its own power
- The separation of aircraft servicing activities from the terminal, and
- Reduced walking distances for the passenger.

Disadvantages:

- Remote location may expose passengers to harsh weather in some cases.
- Increase passenger processing time
- Unnecessary delay may result
Transporter, Open Apron or Mobile Conveyance Concept Vs other Concepts
Concept Combinations and Variations:

Combinations of concepts and variations are a result of changing conditions experienced from the initial conception of the airport throughout its life span. A combination of concept types can be advantageous where more costly modifications would be necessary to maintain the original concept.

Linear, satellite and pier concepts—O’Hare International Airport.
The basis for distributing the primary processing activities in a passenger terminal among several levels is mainly to separate the flow of arriving and departing passengers. The decision concerning the number of levels a terminal facility should have depends primarily on the volume of passengers and the availability of land for expansion in the immediate vicinity.

**Figure 10-21** Vertical distribution concepts: (a) single level, (b) second level loading, (c) two-level system (Federal Aviation Administration [50]).
The Passenger Terminal System
Vertical Distribution Concepts

**Figure 10-22A** Multilevel passenger processing system—structural parking adjacent to terminal (Hamburg Airport Authority).
The Passenger Terminal System

Applicable Concepts

<table>
<thead>
<tr>
<th>Airport size by enplaned pax/year</th>
<th>Concepts applicable</th>
<th>Physical aspects of concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Linear</td>
<td>Pier</td>
</tr>
<tr>
<td>Feeder under 25,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Secondary 25,000 to 75,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>75,000 to 200,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>200,000 to 500,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Primary over 75% pax O/D 500,000 to 1,000,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Over 25% pax transfer 500,000 to 1,000,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Over 75% pax O/D 1,000,000 to 3,000,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Over 25% pax transfer 1,000,000 to 3,000,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Over 75% pax O/D over 3,000,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Over 25% pax transfer over 3,000,000</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Figure 10-23** Applicable concepts for airport design (Federal Aviation Administration [50]).
Aircraft parking type refers to the manner in which the aircraft is positioned with respect to the terminal building and to the manner in which aircraft maneuver in and out of parking positions. It is an important factor affecting the size of the parking positions and consequently the apron gate area.

- **Nose-In**
- **Parallel**
- **Angled Nose-In**
- **Angled Nose-Out**
The baggage claim lobby should be located so checked baggage may be returned to terminating passengers in reasonable proximity to the terminal deplaning curb.

The number and type of claim devices required is determined by the number and type of aircraft that will arrive during the peak hour, the time distribution of these arrivals, the number of terminating passengers, the amount of baggage checked on these flights, and the mechanism used to transport baggage from aircraft to
The Passenger Terminal System
Baggage Claim Facilities:

Types of Baggage Claim Facilities:

- **Flatbed - Direct Feed**

- **Circular Remote Feed Sloping Bed**

- **Oval Remote Feed Sloping Bed**
The Passenger Terminal System

Baggage Claim Facilities:

Types of Baggage Claim Facilities:
The Passenger Terminal System

Baggage Claim Facilities:

Types of Baggage Claim Facilities:
The Passenger Terminal System
Departure Lounge

Areas for optimum configurations of
A Round – sloping bed/remote feed
   Tee – flat bed/direct feed
B Tee and u-shape alternating @ 75’
   (flat bed/direct feed)
C Oval – flat bed/direct feed
   Oval – sloping bed/remote feed
D Tee and u-shape alternating @ 60’
   (flat bed/direct feed)
E II – shape flat bed/direct feed

*Based on 1.3 average bags per passenger