

Introduction to Airports Design and Operations

Learning Objectives:

Student will be able to describe the following terms:

Terminal building	Tower Control
Concourses	Controlled Airspace
Runways	Movement Areas
Hangars	Traffic Pattern
Landside	Navigational Aid
Airside	ATIS
Fixed-base Operators	VASI
Air Traffic Control	VOR
Emergency Services	DME
Airbase	PAR
Airfield	ILS
Airstrip	Location Signage
Aerodrome	Direction/Runway Signage
Ramp	Change Frequency Signage
Apron	Holding Position Signage
Jetbridge	Runway Lighting
Air Traffic Control	Runway Edge Lighting
Customs	Taxiway Lighting
Cargo & Freight Services	Taxiway Edge Lighting
Navigation Aids	Wind Sock
ICAO	Windshear
IATA	Airport/Facility Directory
Ground Control	Airport Diagram

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Airports

An airport is a facility where passengers connect from/to ground transportation to air transportation. Descriptions of airports can be divided into landside and airside. Landside descriptions cover how passengers arrive/depart the airport terminal building and move through the terminal building to board the airplanes. Airside describes the movement of the airplanes on the airports surface.

At the very minimum, an airport consists of one runway (or helipad), but other common components are hangars and terminal buildings. Apart from these, an airport may have a variety of facilities and infrastructure, including fixed base operator services, air traffic control, passenger facilities such as restaurants and lounges, and emergency services.

A military airport is known as an airbase in North American terminology. The terms airfield and airstrip may also be used to refer to a facility that has nothing more than a runway. The term aerodrome refers to any surface used for take off or landing. The term airport refers to an aerodrome that is licensed by the responsible government organization (ie FAA). Airports have to be maintained to higher safety standards. There is usually no minimum standards for a basic aerodrome.

Airport Characteristics

Airports vary in size, with smaller or less-developed airports often having only a single runway shorter than 1,000 m (3,300 ft). Larger airports for international flights generally have paved runways 2,000 m (6,600 ft) or longer. Many small airports have dirt, grass, or gravel runways, rather than asphalt or concrete.

In the United States, the minimum dimensions for dry, hard landing fields are defined by the FAR Landing And Takeoff Field Lengths. These include considerations for safety margins during landing and takeoff. Typically heavier aircraft require longer runways.

The longest public-use runway in the world is at Ulyanovsk-Vostochny International Airport, in Ulyanovsk, Russia. It has a length of 16,404ft.

As of 2008, there were approximately 50,000 airports around the world, including 19,815 in the United States alone.

Airport Structures

Airports are divided into landside and airside areas. Landside areas include parking lots, fuel tank farms and access roads. Airside areas include all areas accessible to aircraft, including runways, taxiways and ramps. Access from landside areas to airside areas is

tightly controlled at most airports. Passengers on commercial flights access airside areas through terminals, where they can purchase tickets, clear security, check or claim luggage and board aircraft. The waiting areas which provide passenger access to aircraft are typically called concourses, although this term is often used interchangeably with terminal.

The area where aircraft park next to a terminal to load passengers and baggage is known as a ramp. Parking areas for aircraft away from terminals are generally called aprons.

Both large and small airports can be towered or uncontrolled, depending on air traffic density and available funds. Due to their high capacity and busy airspace, most international airports have air traffic control located on site.

International Customs

Customs facilities for international flights define an international airport, and often require a more conspicuous level of physical security. International airports generally have a complex of buildings where passengers can embark on airliners, and where cargo can be stored and loaded.

The largest international airports are often located next to highways or are served by their own highways. Often, traffic is fed into two access roads, designed as loops, one sitting on top of the other. One level is for departing passengers and the other is for arrivals. Many airports also have light rail lines or other mass transit systems directly connected to the main terminals.

Shops and Food Services

Most international airports have shops and food courts. These services provide passengers food and drinks before they board their flight. Many recognizable chain food restaurants have opened branches in large airports to serve passengers. London's Heathrow Airport, for example, is home to both a Harrods and a Hamleys Toy Shop, providing Duty Free for international passengers.

International areas usually have a duty-free shop where travelers are not required to pay the usual duty fees on items. Larger airlines often operate member-only lounges for premium passengers.

Airports have a captive audience, and consequently the prices charged for food is generally higher than are available elsewhere in the region. However, some airports now regulate food costs to keep them comparable to so-called "street prices".

Cargo and Freight Services

In addition to people, airports are responsible for moving large volumes of cargo around the clock. Cargo airlines often have their own on-site and adjacent infrastructure to rapidly transfer parcels between ground and air modes of transportation.

Support Services

Aircraft maintenance, pilot services, aircraft rental, and hangar rental are most often performed by a fixed base operator (FBO). At major airports, particularly those used as hubs, airlines may operate their own support facilities.

History and Development

The earliest airplane landing sites were simply open, grassy fields. The airplane could approach at any angle that provided a favorable wind direction. Early airfields were often built for the purpose of entertainment. These aerodromes consisted of a grassy field, with hangar for storage and servicing of airplanes, and observation stands for the visitors.

Increased aircraft traffic during World War I led to the construction of regular landing fields. Airplanes had to approach these from specified directions. This led to the development of navigation aids for directing the approach and landing slope.

Following the war, some of these military airfields added commercial facilities for handling passenger traffic. One of the earliest such fields was Le Bourget, near Paris. The first international airport to open was the Croydon Airport, in South London. In 1922, the first permanent airport and commercial terminal solely for commercial aviation was built at Königsberg, Germany. The airports of this era used a paved "apron", which permitted night flying as well as landing heavier airplanes.

The first lighting used on an airport was during the later part of the 1920s; in the 1930s approach lighting came into use. These indicated the proper direction and angle of descent. The colors and flash intervals of these lights became standardized under the ICAO. In the 1940s, the slope-line approach system was introduced. This consisted of two rows of lights that formed a funnel indicating an aircraft's position on the glideslope. Additional lights indicated incorrect altitude and direction.

Following World War II, airport design began to become more sophisticated. Passenger buildings were being grouped together in an island, with runways arranged in groups about the terminal. This arrangement permitted expansion of the facilities. But it also meant that passengers had to travel further to reach their airplane.http://www.experiencefestival.com/airport_-_history_and_development

Airport Designation and Naming

Airports are uniquely represented by their IATA airport code and ICAO airport code. IATA airport codes are often, but not always, abbreviated forms of the common name of the airport, such as PHL for Philadelphia International Airport. Exceptions to this rule often occur when an airport's name is changed. O'Hare International Airport in Chicago, Illinois retains the IATA code ORD, from its former name of Orchard Field.

In many countries airports are often named after a prominent national celebrity, commonly a politician, e.g. John F. Kennedy International Airport, Indira Gandhi International Airport or Charles de Gaulle International Airport.

IATA: IATA is an international trade body, created some 60 years ago by a group of airlines. Today, IATA represents some 230 airlines comprising 93% of scheduled international air traffic. The organization also represents, leads and serves the airline industry in general. <http://www.iata.org>

ICAO: The International Civil Aviation Organization, a UN Specialized Agency, is the global forum for civil aviation. ICAO works to achieve its vision of safe, secure and sustainable development of civil aviation through cooperation amongst its member States. <http://www.icao.int>.

Security

Airports are required to have safety precautions in most countries. Rules vary in different countries, but there are common elements worldwide. Airport security normally requires baggage checks, metal screenings of individual persons, and rules against any object that could be used as a weapon. Since the September 11, 2001 attacks, airport security has been dramatically increased worldwide.

Airport Operations

Outside the terminal, there is a large team of people who work in collaboration to ensure aircraft can land, take off, and move around quickly and safely. These processes are largely invisible to passengers, but have extraordinary complexity at large airports.

Air Traffic Control

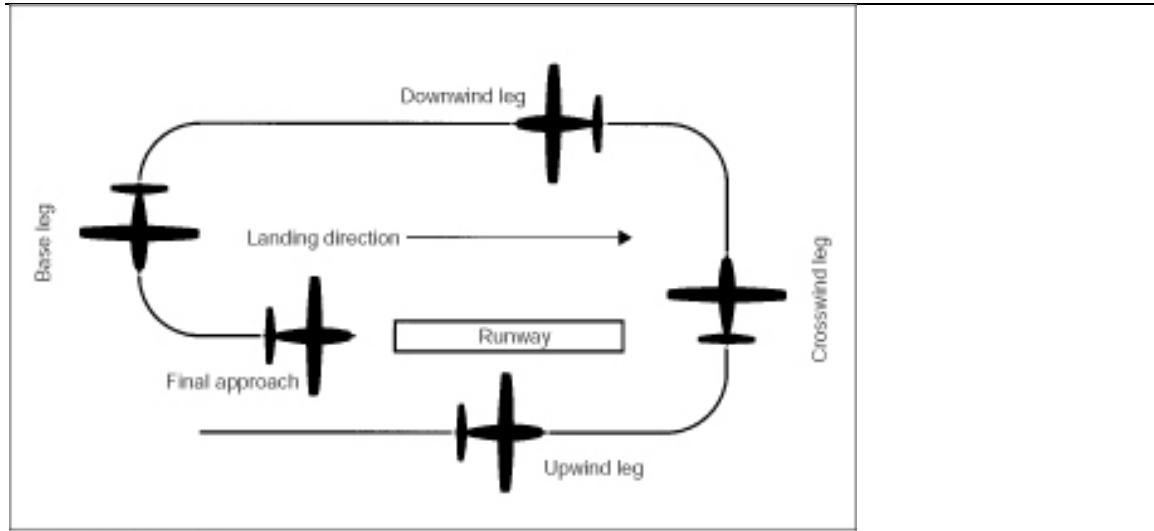
Air traffic control (or ATC) is system whereby ground-based controllers direct aircraft movements, usually via push-to-talk VHF radio. This coordinated oversight facilitates safety and speed in complex operations where traffic moves in all three dimensions. Air traffic control responsibilities at airports are usually divided into two main areas: ground and tower.

Ground Control is responsible for directing all ground traffic in designated "movement areas," except the traffic on runways. This includes planes, baggage trains, snowplows, grass cutters, fuel trucks, and a wide array of other vehicles. Ground Control will instruct these vehicles on which taxiways to use, which runway they will use (in the case of planes), where they will park, and when it is safe to cross runways. When a plane is ready to take off it will stop short of the runway, at which point it will be turned over to Tower Control. After a plane has landed, it will depart the runway and be returned to Ground Control.

Tower Control controls aircraft on the runway and in the controlled airspace immediately surrounding the airport. Tower controllers use radar to identify and accurately locate an aircraft's position in three-dimensional space. They coordinate the sequencing of aircraft in the traffic pattern and direct aircraft on how to safely join and leave the circuit. Aircraft which are only passing through the airspace must also contact Tower Control in order to be sure that they remain clear of other traffic and do not disrupt operations.

Traffic Pattern vs. Scheduled Operations

Smaller airports and military airfields use a traffic pattern to assure smooth traffic flow between departing and arriving aircraft. Generally, this pattern is a circuit consisting of five "legs" that form a rectangle (two legs and the runway form one side, with the remaining legs each form another side). Each leg is named (see diagram), and ATC directs pilots on how to join and leave the circuit. Traffic patterns are flown at one specific altitude, usually 1000 ft AGL. Most traffic patterns are left-handed, meaning all turns are made to the left. Right-handed patterns do exist, usually because of obstacles such as a mountain or to reduce noise for local residents. The predetermined circuit helps pilots look for other aircraft, and helps reduce the chance of a mid-air collision.



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At large airports, a circuit is not usually used. Rather, ATC schedules aircraft for landing while they are still hours away from the airport. Airplanes can then take the most direct approach to the runway and land without worrying about interference from other aircraft. While this system keeps the airspace free and is simpler for pilots, it requires detailed knowledge of how aircraft are planning to use the airport ahead of time and is therefore only possible with large commercial airliners on pre-scheduled flights. The system has recently become so advanced that controllers can predict whether an aircraft will be delayed on landing before it even takes off; that aircraft can then be delayed on the ground, rather than wasting expensive fuel waiting in the air.

Airport - Navigational Aids

Before takeoff, pilots check the Automatic Terminal Information Service (ATIS) for information about airport conditions where they exist. The ATIS contains information about weather, which runway and traffic patterns are in use, and other information that pilots should be aware of before boarding the aircraft and entering the movement area and the airspace.

When flying, there are a number of aids available to pilots, though not all airports are equipped with them. A Visual Approach Slope Indicator (VASI) helps pilots fly a perfect approach for landing once they have found the airport. Some airports are equipped with a VHF omnidirectional range (VOR) to help pilots find the direction to the airport. VORs are often accompanied by a Distance Measuring Equipment (DME) to determine the distance to the airport. In poor weather, pilots will use an Instrument Landing System to find the runway and fly the correct approach, even if they cannot see the ground.

Larger airports sometimes offer Precision Approach Radar (PAR). The aircraft's horizontal and vertical movement is tracked via radar, and the controller tells the pilot his position relative to the approach slope. Once the pilots can see the runway lights, they may continue with a visual landing.

Guidance Signs

Airport guidance signs provide direction and information to taxiing aircraft and airport vehicles and assist in safe and expedient movement of aircraft. Smaller airports may have few or no signs, relying instead on airport diagrams and charts.

There are two classes of signage at airports, with several types of each:

- Location signs - yellow on black background. Identifies the runway or taxiway currently on or entering.
- Direction/Runway Exit signs - black on yellow. Identifies the intersecting taxiways the aircraft is approaching, with an arrow indicating the direction to turn.
- Other - Many airports use conventional traffic signs such as stop and yield signs throughout the airport.

Mandatory instruction signs are white on red. They show entrances to runways or critical areas. Vehicles and aircraft are required to stop at these signs until the control tower gives clearance to proceed.

- Runway signs - White on a red. These signs simply identify a runway intersection ahead.
- Frequency Change signs - Usually a stop sign and an instruction to change to another frequency. These signs are used at airports with different areas of ground control.
- Holding Position signs - A single solid yellow bar across a taxiway indicates a position where ground control may require a stop. If a two solid yellow bars and two dashed yellow bars are encountered, this indicates a holding position for a runway intersection ahead; runway holding lines must never be crossed without permission. At some airports, a line of red lights across a taxiway is used during low visibility operations to indicate holding positions.

Lighting

Many airports have lighting that help guide planes using the runways and taxiways at night or in rain or fog.

On runways, green lights indicate the beginning of the runway for landing, while red lights indicate the end of the runway. Runway edge lighting is white lights spaced out on both sides of the runway, indicating the edge. Some airports have more complicated lighting on the runways including lights that run down the centerline of the runway and lights that help indicate the approach. Low-traffic airports may use Pilot Controlled Lighting to save electricity and staffing costs.

Along taxiways, blue lights indicate the taxiway's edge, and some airports have embedded green lights that indicate the centerline.

Wind Indicators

Planes take-off and land into the wind in order to achieve maximum performance. Wind speed and direction information is available through the ATIS or ATC, but pilots need instantaneous information during landing. For this purpose, a windsock is kept in view of the runway.

Safety Management

Air safety is an important concern in the operation of an airport, and almost every airfield includes equipment and procedures for handling emergency situations. Commercial airfields include one or more emergency vehicles and their crew that are specially equipped for dealing with airfield accidents, crew and passenger extractions, and the hazards of highly flammable airplane fuel. The crews are also trained to deal with situations such as bomb threats, hijacking, and terrorist activities.

Potential airfield hazards to aircraft include debris, nesting birds, and environmental conditions such as ice or snow. The fields must be kept clear of debris using cleaning equipment so that loose material doesn't become a projectile and enter an engine duct. Similar concerns apply to birds nesting near an airfield, and crews often need to discourage birds from taking up residence. In adverse weather conditions, ice and snow clearing equipment can be used to improve traction on the landing strip. For waiting aircraft, equipment is used to spray special deicing fluids on the wings.

During the 1980s, a phenomenon known as microburst became a growing concern due to accidents caused by microburst wind shear. (For example, see Delta Air Lines Flight 191.) Microburst radar was developed as an aid to safety during landing, giving two to five minutes warning to aircraft in the vicinity of the field of an microburst event.

Learn More About It:

AIRCRAFT ACCIDENT REPORT, DELTA AIR LINES, INC., LOCKHEED L-101 1-385-1, N726DA, DALLAS/FORT WORTH - INTERNATIONAL AIRPORT, TEXAS, AUGUST 2, 1985, NTSBIAAR-86/05

<http://www.airdisaster.com/reports/ntsb/AAR86-05.pdf>

TIME MAGAZINE Monday, Apr. 18, 2005
"Like a Wall of Napalm" (By Ed Magnuson)

As Delta Air Lines Flight 191, a wide-bodied Lockheed L-1011 with 160 aboard, approached Dallas/Fort Worth Airport last Friday, the north Texas sky abruptly turned dark gray. Clouds welled up and burst into showers, and lightning bolts zigzagged menacingly. A meteorologist later estimated that a downdraft was rushing through the thunderstorm cell at 80 m.p.h. The huge plane descended, but suddenly plunged belly first to the ground a mile north of Runway 17 at the nation's largest airport (roughly the size of Manhattan). The L-1011 bounced off the turf and came down again a quarter-mile away, grazing one car on busy State Highway 114 and demolishing a second car, whose driver was decapitated. The plane skipped across a grassy field, ricocheted off a water tower, then burst into flames as it slid across the tarmac. "It was like a wall of napalm," said Airline Mechanic Jerry Maximoff. The tail section, with one of the plane's three engines and the last ten rows of seats, was the only recognizable part of the wreckage.

Somehow 31 people, including three flight attendants, initially survived the impact and subsequent inferno. "It was all sunshine until we actually started coming down," said Jay Slusher, 33, a computer programmer who was going to catch another plane for his home in Phoenix. "Then the rain started, very heavy. It became so dark you couldn't even see out the windows. The ride got rougher and rougher. It seemed like there was something on top of the plane, pushing it to the ground. The pilot tried to pull out of it. The speed of the engines increased. We started rocking back and forth. Then we were tossed all around. I saw an orange streak coming toward me on the left side of the floor. I thought we were going to explode. At that point, I said, 'Well, it's all over.' The next thing that happened is that I ended up sitting in my seat on my side. I looked up and I could see the grass. I said, 'Thank you, Lord,' unbuckled my seat belt and jumped out."

Gilbert Green, 21, a football player at Florida State University, was sitting on the right side of the plane as the fire broke out. "It started to singe my arm," he recalled. "Right then the plane broke in half and I was shot out of the way of the fire. [The fuselage] broke off right in front of me. All the seats in front of me went the other way." Most of the survivors were in the smoking section. Said one: "That's the first time a cigarette ever saved my life." Even two dogs in the rear cargo section were saved.

Rescue workers toiled at first in a nearly horizontal driving rain. They placed yellow sheets over the dead, quickly assessed the severity of survivors' injuries and warned area hospitals by radio about what type of cases to expect. The Rev. Richard Brown, who was giving last rites to the victims, was startled when he saw the stomach of one, a baby, "going up and down." He baptized the infant instead and alerted medics, but the child later died. Most of the injured were taken by helicopter or ambulance to Parkland Memorial Hospital in Dallas, where doctors had tried to save John F. Kennedy in 1963. Officials were heartened by the local response to appeals for blood donations. Some 1,500 people lined up to give.

As night fell, a large crane lifted pieces of wreckage in the search for bodies. Four were found under the landing gear. Floodlights illuminated the scene, which included the grotesque sight of corpses being loaded into refrigerator trucks labeled LIVE MAINE LOBSTERS. All three members of the cockpit crew were killed. The pilot, Captain Ted Connors, 57, had flown for Delta for 31

years. One passenger survived because she made a lucky decision. Assigned a front seat before takeoff from Fort Lauderdale, Annie Edwards, of Pompano Beach, Fla., shifted to a rear seat beside a friend, Juanita Williams. Both survived. They were among a group of women going to Dallas to attend a convention of Delta Sigma Theta, a sorority. Other passengers were heading for Los Angeles, the flight's last stop. Friends checking the arrivals list there found a curt message: "Flight 191. See agent."

Environmental Concerns

The traffic generated by airports both in the air and on the surface can be a major source of aviation noise and air pollution which may interrupt nearby residents' sleep or, in extreme cases, be harmful to their health . The construction of new airports, or addition of runways to existing airports, is often resisted by local residents because of the effect on the countryside, historical sites, local flora and fauna. As well, due to the risk of collision between birds and airplanes, large airports undertake population control programs where they frighten or shoot birds to ensure the safety of air travelers.

The construction of airports has been known to change local weather patterns. For example, because they often flatten out large areas, they can be susceptible to fog in areas where fog rarely forms. In addition, because they generally replace trees and grass with pavement, they often change drainage patterns in agricultural areas, leading to more flooding, run-off and erosion in the surrounding land.

Airport Directories

Each national aviation authority has its own system for pilots to be able to keep track of information about airports in their country.

The United States uses the **Airport/Facility Directory (A/FD)**, seven volumes that contain information such as elevation, airport lighting, runway information, communications, hours of operation, nearby NAVAIDs and much more.



Check it at http://naco.faa.gov/index.asp?xml=naco/online/d_afd

Airports in the Movies



Airports have played major roles in motion pictures and television shows due to being transportation hubs, but also because of their unique characteristics.

The Terminal, a film about a man who becomes permanently grounded in an airport terminal and must survive only on the food and shelter provided by the airport. If nothing else, this movie demonstrates the sustaining properties of airport terminals.

Other movies:

- *Airplane!*
- *Airport, Die Hard II*
- *Jackie Brown*
- *Get Shorty*
- *View from the Top-* a light comedy about one woman's dream to work international routes for an airline.