Airports & Terminals

Technical English - II
6th week

Airports & Terminals

Air terminals are one of the two major components of air transportation. The following items are taken into consideration during the design stage of air terminals:

• Air Transportation
• Aircraft Characteristics Related to Airport Design
• Air Traffic Control
• Capacity and Delay
• Runway Orientation
• Airport Planning
• Runway Length
• Terminal Area

AIRPORT DESIGN

The aim of this presentation is to give the definitions and the basic principles of air transportation and airport engineering. It should be noted that knowledge of highway engineering, soil mechanics, statics and earthworks are needed during design process.

AIR TRANSPORTATION

South Atlantic was crossed overflown by a commercial flight for the first time in 1930. Pacific Ocean was crossed in 1937.

These flights over the ocean were done by “sea planes” capable of taking off and landing on water. It is after the World War II, in 1945 that flights over the oceans were made by airplanes.

It is in 1958 that Trans-Atlantic and Pacific flights have been realized by “jet airplanes”.

It is seen that, starting from almost nothing 70 years ago, air transportation gained a very important place in economic and social life of many nations.

AIR TRANSPORTATION CATEGORIES

Air transportation is divided into four categories as follows:

- Category A: involves long-distance transportation greater than 3000 km
- Category B: involves medium and short distance scheduled transportation
- Category C: involves the chartered travels, air works and general aviation
- Category D: groups elementary and diverse aviation such as aviation school, training, air clubs etc.

INTERNATIONAL CHARACTER OF AERONAUTICS

One of the essential characters of the aeronautics is its international character. Every country desiring to receive air traffic coming from or going abroad can not organize her aviation and her aeronautical infrastructure as she wants. She cannot adopt regulations elaborated by herself. An international coordination is necessary. It can be said that in highway and railway transportation such coordination is also necessary. But in air transportation its role is much important. A complete safety should be provided to the aircraft of a country using the airport of another country.

By the invention of airplanes at the beginning of the 20th century, and the jet-aircraft later, the rate of progress in transportation reached to astonishing levels as indicated qualitatively in the figure.

The first commercial flight to carry passengers has taken place in 1908. The first commercial line was opened between Paris and London by a French airplane in 1919. The first air line company performing scheduled flights whole year has been opened in the U.S.A in 1925. These two events caused the entrance of air transportation into the modes of transportation offering “regular service open to the public during whole year”.

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**AIR TRANSPORTATION IN TURKEY**

In Turkey, in 2007, according to the Turkish Airlines, air traffic on the domestic routes, which was 532,053 in 2002, rose to a record-breaking 1,009,064 in 2008. On the domestic routes alone there has been a 143% increase in airplane traffic from 15,600,000 in 2002 to 385,000 today.

In 2007, number of passengers in domestic lines 31,970,874 and in international lines 38,381,993 totally 70,352,867. According to General Directorate of State Airports in 2007 number of passengers was 66,461,973 (transportation in the Sabiha Gökçen, Batman, Zonguldak-Çaycuma and Eskisehir Anadolu University Airports are not included). Also, in 2007 freight carried (tons) was 1,447,603. In 2008 total passenger traffic at airports was 74,968,329.

13 airports have international standards and are open to international traffic. ( Atatürk, Esenboğa, Adnan Menderes, Adana, Antalya, Bodrum, Sabiha Gökçen, Trabzon, Erzurum, Gaziantep, Nevşehir, Süleyman Demirel, Dalaman)

3 airports are opened to international chartered flights and scheduled domestic flights (Adana, Dalaman, Nevşehir)

c. General Directorate of Air Transportation (Hava Ulaştırma Genel Müdürlüğü),

38 airports have international standards and are open to international traffic.

- Actually there are 117 airports in Turkey used for air transportation purposes.

**AIRCRAFT CHARACTERISTICS RELATED TO AIRPORT DESIGN**

**GENERAL**

Air vehicles (used for air transportation) can be classified into the following categories:

a. **Airplanes**

   Airplane means an engine-driven fixed wing aircraft heavier than air that is supported in flight by the dynamic reaction of the air against wings.

b. **Flying boats**

   They are the planes designed to land on water and to take off from water surface.

   They were used widely in the past when the speed of airplanes did not exceed 250–300 km/h because they did not necessitate runways and they had a large capacity. But today they have almost disappeared.

c. **Airship**

   Airship means an engine-driven lighter than air aircraft that can be steered. They were used in the past but today they have completely disappeared.

d. **Giders**

   The gliders are the plane without engine. To be able to fly, they should be thrown into the air. They are under use for training purposes.

e. **Helicopters**

   Helicopter means a rotorcraft that, for its horizontal motion, depends principally on its engine-driven rotors.

   **HYPERLINK:** Airship and gliders are not used for air transportation.

**NATIONAL ORGANIZATIONS**

In Turkey, the following organizations are directly concerned with aviation:

a. General Directorate for the Construction of Railroads, Harbors and Airports (DHL Demiryolları, Limanlar ve Havayollarları İnci Genel Müdürlüğü)

   Ministry of Communication deals with the construction, reconstruction, improvement, development and major repairs of airports.


   Ministry of Communication: operates, maintains (and sometimes repair) all the civil airports, the airways and air traffic facilities.
Definition of terms related to aircraft dimensions

A McDonnell Douglas MD-11

The characteristics shown in the previous tables are important for the design of airports in the following manner:

WEIGHT: Aircraft weight is important for determining the thickness of runway, taxiway, and apron pavements. It is also important to determine the length of runway.

SIZE: The wingspan and the fuselage length influence the size of parking aprons which in turn influences the configuration of the terminal building. Size also dictates width of runways and taxiways.

CAPACITY: The passenger capacity has an important bearing on facilities within the adjacent to the terminal building.

RUNWAY LENGTH: The length of runway influences a large part of the land area required at an airport. The lengths provided in the tables are only approximate. For specific cases, the length required for a given aircraft should be calculated.

An examination of the tables reveals the following:

Maximum take-off weight of principal airline aircraft vary from 42,000 kg (92,500 lbs) to 500,000 kg (1,100,000 lbs). For small general aviation aircraft, the range in weight is from 4,400 kg (2,000 lbs) to 125,600 kg (57,000 lbs). The maximum number of passengers carried by airline aircraft varies from 65 to nearly 900.
On the other hand, small general aviation airplanes seat from 2 to 6 people, and corporate aircraft from less than 10 to nearly 30 persons depending on the configuration of the interior. Runway lengths for typical airline aircraft vary from 2.100 m to 3.200 m, but it is important to note that it is not valid to assume that the larger the weight of an aircraft, the longer the runway length required. For large aircraft, especially the trip length has a profound influence on take-off weight and hence the required runway length. Therefore, in the analysis of runway requirements, an estimate of trip length is very important. Runway lengths for small general aviation aircraft seldom exceed 650 m, while for corporate aircraft they are on the order of 1650 m.

Primary runways are the ones which are normally used. Hence the location of terminal area is determined with respect to these runways in order to reduce the movement of aircraft on the ground. Secondary runways may or may not have the same length as primary runways. They may be 20% shorter than the primary runways. They may be shorter because they are employed when a strong wind forbid the utilization of the primary runway and these winds blow in the same direction as the secondary runway and reduces the landing and take-off distances. They are also constructed if small aircraft is undesirable on the primary runways.

In the design of airport pavements, the design wheel load may be that of the largest plane (critical plane) which will use the field. Traffic on an airfield is such that the distribution of traffic is concentrated primarily in the center. As a general rule, the traffic on a runway is distributed over about 60 feet (18 m) of the pavement. Airport runways need to be very smooth and free from any loose material that might hurt the plane or people. It is not a very big deal for there to be stone pieces on the highway. This happens all the time. We even get potholes on the highway and don’t necessarily have to rush to fix it. If this were to happen on a runway, it could mean the cost of human life. The materials used for airports is generally the same as what is used for roadways, however, the depths, or thicknesses are different, and the tolerances are much tighter at an airport. The material for runways usually needs to meet a much tighter spec.

After determining the location and orientation of runway with respect to cross winds. The length of the runways should be determined.

RUNWAY CATEGORIES
Runways are divided into two categories according to their use:

a. Primary Runways
b. Secondary Runways

Primary runway(s) are the longest runways of an airport. They are the ones which have the least obstacles and have the best orientation with respect to cross winds.

Runways of an airport

In the tables given in previous slides, aircrafts are referred to according to the type of propulsion and thrust-generating medium. The term “piston engine” applies to all propeller-driven aircraft powered by gasoline-fed reciprocating engines. Most small general aviation aircraft are powered by piston engines. The term “turbojet” refers to propeller-driven aircraft powered by turboshaft engines. A few twin-engine general aviation aircraft and a few of earlier airline aircraft are powered in this manner. The term “turbofan” has reference to those aircraft which are not dependent on propellers for thrust, but which obtain the thrust directly from a turbine engine. The early jet aircraft particularly Comet, Boeing 707’s and DC-8’s were powered by turbojet engines, but these were discarded in favor of “turbofan engines” principally because the latter are far more economical.

The design load for a major highway is ordinarily in the vicinity of 9000 lbs (4080 kg) or dual tires, and the expected repetitions may be as much as 1000 to 2000 trucks per day. In contrast, a heavy airplane may have wheel loads in excess of 100000 pounds (45 tons), but only 20000 to 40000 coverage may be considered for the life of the pavement.

The above figure shows a typical generic section for an airport where asphalt or concrete may be used for top cover. It may be noticed that the materials in the middle are thicker than that on the bottom. This is because the loads on the runway are primarily from the 2 landing wheels, which will touch down the pavement in the middle of the runway.
The effective tire width is essential while determining the geometry and strength characteristics of an airport pavement for given aircraft types.

- The surface must be smooth and well bonded, and resistant to the shear stresses of the airplane wheel loads. The non-skid surface must not cause undue wear on the airplane tires. The surface must be free of loose particles that could damage the airplane or people. In order to meet this requirement, there must be good control of the mix. This usually requires a central mixing plant be used for the hot mix asphalt.
- The base course is integral to flexible pavement design such as asphalt. The loading in flexible pavements transfers downward and outward. For this reason, the base, subbase, if used, and subgrade contribute to the strength of the pavement section. For concrete pavement, the concrete provides the strength to the structural section.
- The base course must be of sufficient quality that it won't fail, or allow failure in the subgrade. It must be able to withstand the forces from the airplane wheel loading without consolidating which would cause the surface course to deform. The base course uses very select material with very hard and durable aggregate. The requirements for the base course are very strict.

AIR TRAFFIC CONTROL

In order that the airport designer may be aware of the importance of air traffic control in airport planning, a very brief summary of what constitutes air traffic control, how it is managed and operated and the principal aids to aerial navigation shall be covered in courses targeting airport design and management.

As the speed of aircraft and density of traffic in the airspace increased there was more concern over the possibility of midair collisions. This concern was substantiated by the occurrence of several such collisions involving many lives. Accordingly, in certain parts of the airspace, IFR rules have been prescribed regardless of weather conditions. This is referred to as “positive control airspace”. Positive control usually encompasses the airspace where high-speed jet aircraft operate; therefore it can include the airspace in the vicinity of airports as well as the space in which jets fly on route from a city to another.

Conformance with instrument flight rules requires that, prior to departure, the pilot file with the air traffic control centre a «flight plan» which indicates the traffic destination, the desired routes, and the desired altitudes. The flight plan is continuously updated as the flight progresses.
The control tower of the 3rd Istanbul Airport is under construction.

The terminal area is the major area of interface between the airfield and the rest of the airport. It includes the facilities for;

a. Passenger handling,

b. Cargo handling,

c. Maintenance,

d. Administration.

The Passenger-handling System

The passenger-handling system is the major connection between airport access and the aircraft. The purpose of the passenger-handling system is to;

a. Interface with the passenger's mode of airport access

b. Process the passenger for starting or ending an air trip

c. Convey the passenger to and from the aircraft

The passenger-handling system is composed of three major components. These components and the activities that occur within them are as follows:

a. Access interface: Here the passenger transfers from the access mode of travel to the passenger-processing component. Circulation, parking and curb side loading and unloading of passengers are the activities that take place in this component.

b. Processing: Here the passenger is processed in preparation for starting or ending an air trip. The primary activities that take place here are ticketing, baggage check-in, baggage claim, and control

c. Flight interface: Here the passenger transfers from the processing component to the aircraft. The activities that occur here include assembly, conveyance to and from the aircraft, and aircraft loading and unloading.
CARGO-HANDLING

At large airports, where the cargo volume is high, it is usually processed at a cargo terminal that is separate from the passenger terminal. However, the increase in large jet aircraft operations had led to a rise in the occurrence of mixed passenger and cargo operations. This is due to the fact that large jet aircraft have a high cargo-carrying capacity in excess of what is needed to carry passengers and baggage. Therefore, it is essential when planning the apron area to take cargo-handling considerations into account.

Cargo is composed of air freight and airmail. Airmail is usually conveyed by the carrier to a central airport airmail facility. Air freight is conveyed between the aircraft and the cargo terminal either by the carrier or by an air-freight forwarder.

Northwest Airlines, Inc. / Detroit Metropolitan Wayne County Airport

Northwest Airlines designed and built a spectacular, state-of-the-art terminal at Wayne County’s Detroit Metropolitan Airport. The project included the construction of a new international/domestic terminal (the ‘Midfield Terminal’) with 97 gates, airfield connections via aprons and taxiways, a large parking structure with 11500 spaces, a multi-level system of access roads to the new terminal, and a power plant.

Foundation works, March 1999
Major milestone: The first steel column goes up, construction of the terminal building begins, August 11, 1999.

Steel structure in progress, April 2000.
This 1.2 billion dollar expansion opened on February 24, 2002. The terminal was named after Wayne County commissioner Edward McNamara.