UNIT-3
AIRPORT ENGINEERING

Airport Engineering

Airport engineers design and construct airports. Airport engineers must account for the impacts and demands of aircraft in their design of airport facilities. These engineers must use the analysis of predominant wind direction to determine runway orientation, determine the size of runway border and safety areas, different wing tip to wing tip clearances for all gates and must designate the clear zones in the entire port. Aviation is the design, development, production, operation, and use of aircraft.

Role of Air transportation:

•Improves accessibility to otherwise inaccessible areas

•Provides continuous connectivity over land and water (no change of equipment)

•Saves productive time, spent on journey

•Increase the demand of specialized technical skill workforce

•Adds to the foreign reserve through tourism

•Speed: Modern jet can travel at 1000 km/h

•Promotion of trade and commerce

•Military use

•Relief and rescue operations

•Aerial photography

•Agricultural spraying

•Safety: safe mode of transport.

Classification of Airports:

There are different classifications by the related organizations such as ICAO, FAA etc.

Based on take-off and landing

- Conventional take-off and landing airport (runway length > 1500 m.

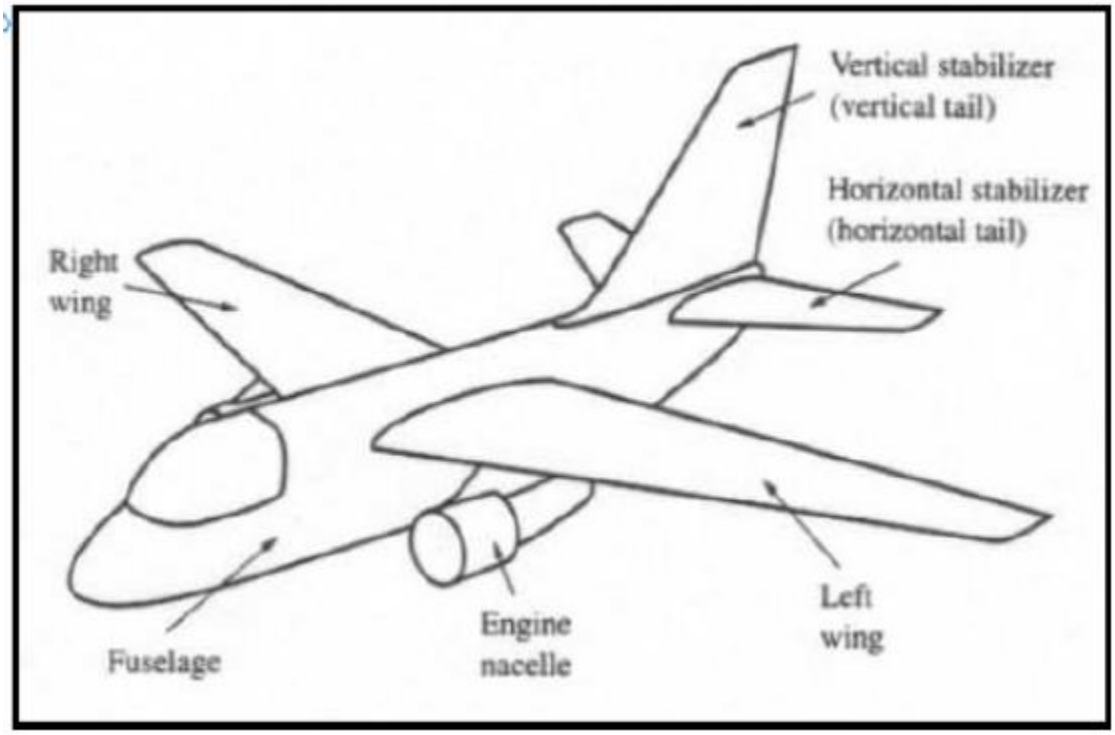
- Reduced take-off and landing airport (runway length 1000 to 1500m)

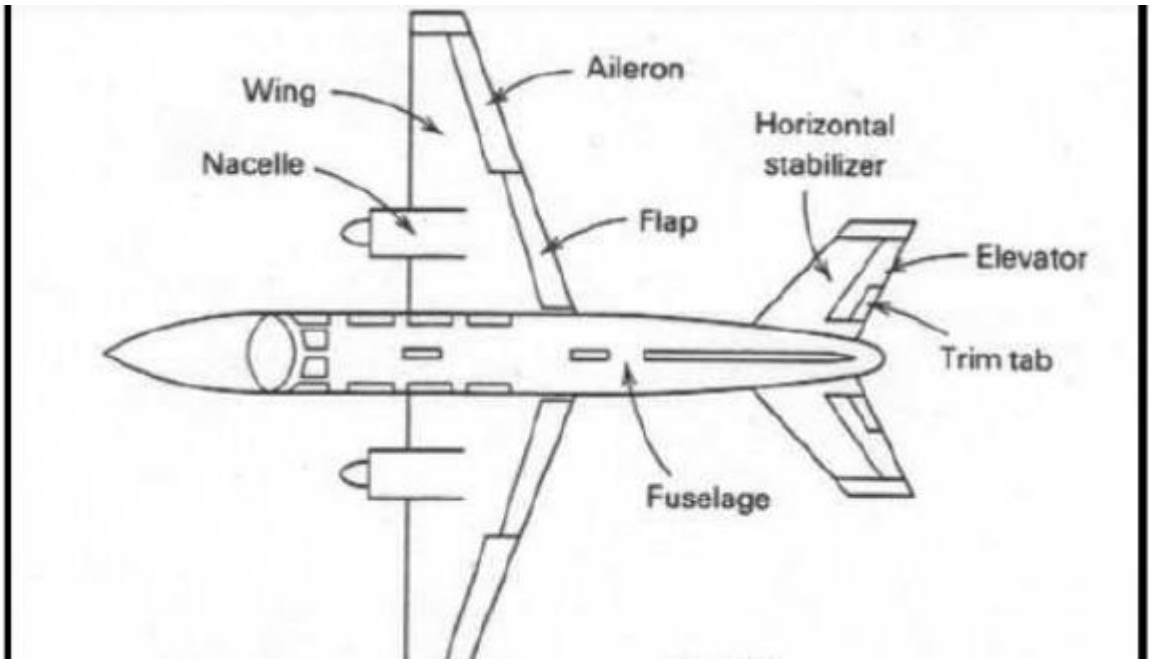
- Short take-off and landing airport (runway length 500 to 1000m)

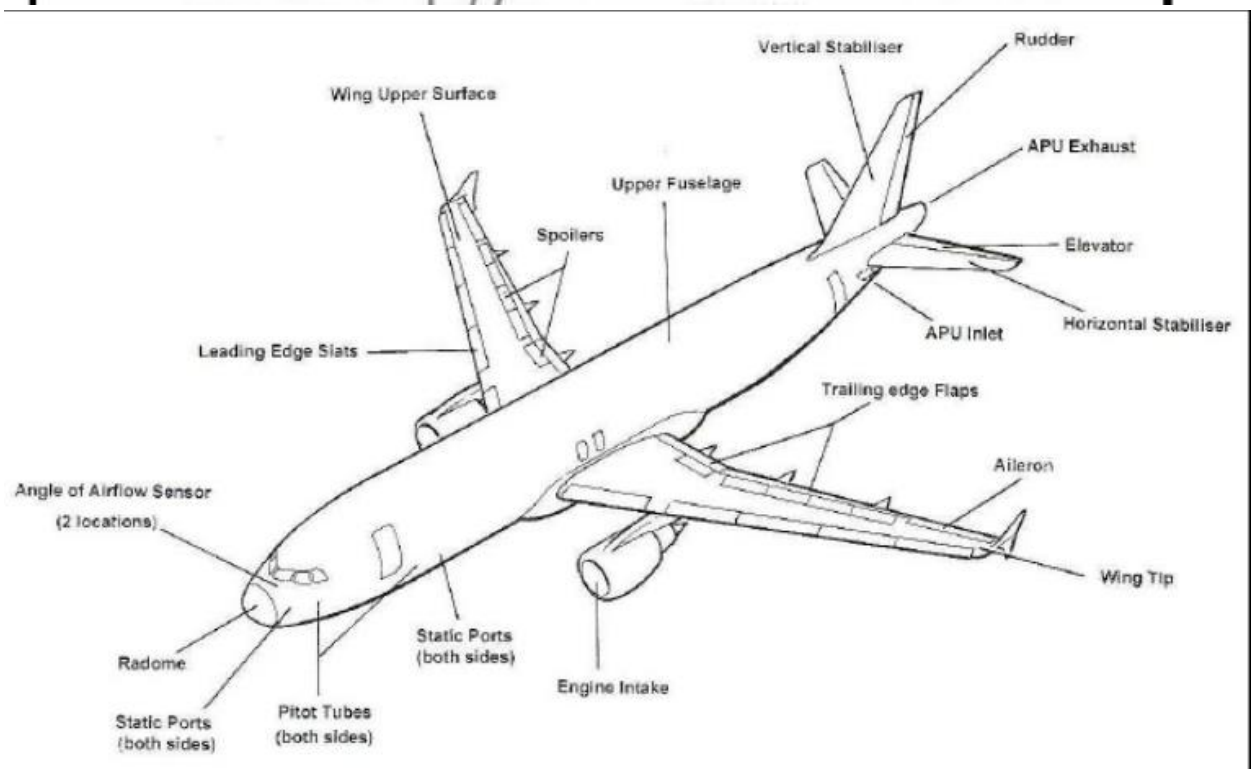
- Vertical take-off and landing airport (operational area 25 to 50 sq. m.)

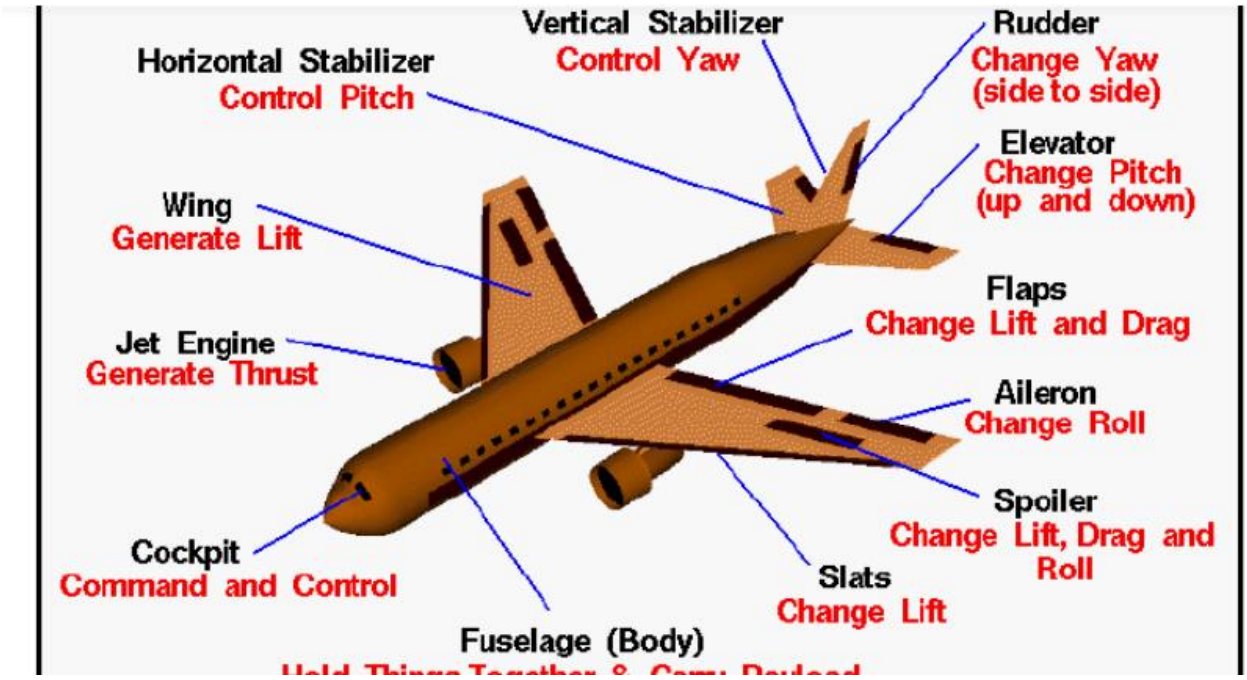
Based on Geometric design (ICAO)

1) It employs aerodrome reference code, it consists of length of runway available
2) Aircraft wing span and outer main gear wheel span.
3) ICAO classification based on wing span and outer main gear wheel span.




Wing
Aileron
Nacelle
Horizontal stabilizer
Flap
Elevator
Trim tab
Fuselage


Vertical Stabiliser
Rudder
Wing Upper Surface
APU Exhaust
Upper Fuselage
Spoilers
Elevator
Horizontal Stabiliser
APU Inlet
Leading Edge Slats
Trailing edge Flaps
Aileron
Angle of Airflow Sensor
(2 locations)
Wing Tip
Static Ports
(both sides)
Radome
Engine Intake
Static Ports
(both sides)
Pitot Tubes
(both sides)



Aircraft Characteristics:

1. Engine type and propulsion
2. Size of aircraft
3. Minimum turning radius
4. Minimum circling radius
5. Speed of aircraft
6. Capacity of the aircraft
7. Aircraft weight & wheel configuration
8. Jet Blast
9. Fuel spillage

Airport Site Selection

Suitable site for airport depends upon the class of the airport. Factors to be considered for a suitable airport site are:

1. Consistency with Regional plan

2. Operational capability: airspace considerations, obstructions, weather etc.

3. Airport use: military, civil, etc.

4. Proximity to other airport: minimum spacing between two airports:

•Airport for general aviation under VFR 3.2 km

•For two piston aircraft VFR: 6.4 km

•Piston engine IFR: 25.6 km

•Jet engine aircraft: 160 km. 5.

Ground accessibility: normally it should not exceed 30 minute drive form the city. It is desirable to locate airport adjacent to the highway. 6.

Topography: hill top is most suitable 7.

Visibility: free from fog, smoke haze etc. 8.

Wind: runway orientation should be: landing and takeoff is done by heading into wind. Smoke from city and industry should not blow over the airport. 9.

Noise nuisance: landing and takeoff path should not pas over the residential or industrial areas.

AIRPORT SITE SELECTION

The selection of a suitable site for an airport depends upon the class of airport under consideration. However if such factors as required for the selection of the largest facility are considered the development of the airport by stages will be made easier and economical. The factors listed below are for the selection of a suitable site for a major airport installation:

1. Regional plan

2. Airport use

3. Proximity to other
airport
4. 4.Ground accessibility
5.Topography

6.Obstructions

7.Visibility

8.Wind

9.Noise nuisance

10.Grading , drainage and soil characteristics

11.Future development

12.Availability of utilities from town

13.Economic consideration

RUNWAY ORIENTATION

In the case of runway orientation, the orientation of a runway depends upon the direction of the wind and to some extent on the area available for development. These are the two major components which creates an effect on the direction in which the runways can be oriented. The determination of a runway orientation is a critical task and we have to look at because this is one of influential things, which creates its effect in terms of planning and designing of an airport.

Runways are always orientated in the direction of the prevailing winds, so that we can utilize the force of the wind during take-off and landing operations. In the case of take-off operations, this wind will help us in generating the lift, whereas during the landing operations the same wind will help in generating the drag, so as to stop the landing aircraft. So, that is what is important as far as the orientation of runway is concerned. The reason behind here is that is what we are looking for is the utilizing the maximum the force of the wind at the time of take-off and landing of any aircraft. It is in terms of lift and drag produced.

Wind Rose Diagram

A **wind rose** is a graphic tool used by meteorologists to give a succinct view of how wind speed and direction are typically distributed at a particular location. Historically, wind roses were predecessors of the compass rose (found on charts), as there was no differentiation between a cardinal direction and the wind which blew from such a direction. Using a polar coordinate system of gridding, the frequency of winds over a time period is plotted by wind direction, with color bands showing wind speed ranges. The direction of the longest spoke shows the wind direction with the greatest frequency.

Wind rose diagrams help you visualize wind patterns at a site. Use them to better inform your design decisions, but be aware of unique microclimates and site considerations that wind rose diagrams will not capture.

A "wind rose" diagram is the most common way of displaying wind data, and can be measured in a “speed distribution” or a “frequency distribution". Wind roses can be a yearly average, or can be made for specific seasons; some even include air temperature information.

Wind rose: the wind data direction duration and intensity are graphically represented by a diagram called wind rose. The wind data should usually be collected for a period of at least 5 years and preferably of 10 years so as to obtain an average data with sufficient accuracy.

Wind rose diagrams can be plotted in two types

1. showing direction and duration of wind.

2. Showing direction duration and intensity of wind.

Type – I: This type of wind rose is illustrated in fig. the radial lines indicate the wind direction and each circle represents the duration of wind. The values are plotted along the north direction in fig similarly other values are also plotted along the respective directions. All plotted points are then joined by straight lines. The best direction of runway is usually along the direction of the longest lone on wind rose diagram. If deviation of wind direction up to 22.5º + 11.25ºfrom their direction of runway is thus along NS direction of landing and takeoff is permissible the percentage of time in a year during which runway can safely be used for landing and takeoff will be obtained by summing the percentages of time along NNW, N, NNE, SSE, S and SSW directions. This comes to 57.6 percent. The total percentage of the time therefore comes to 57.0 + 13.5 = 70.5. This type of wind rose does not account for the effect of cross wind component.

Type – II: This type of wind rose is illustrated in fig. the wind data as in the previous type is used for this case. Each circle represents the wind intensity to some scale. The values entered in each segment represent the percentage of time in a year during which the wind having a particular intensity blows from the respective direction. The procedure for determining the orientation of

runway from this type of wind rose is described below. Draw three equi spaced parallel lines on a transparent paper strip in such a way that the distance between the two nearby parallel lines is equal to the permissible cross wind component. This distance is measured with the same scale with which the wind rose diagram is drawn the permissible cross wind component is 25kph. Place the transparent paper strip over the wind rose diagram in such a way that the central line passes through the centre of the diagram. With the centre of wind rose rotate the tracing paper and place it in such a position that the sum of all the values indicating the duration of wind within the two outer parallel lines is the maximum. The runway should be thus oriented along the direction indicated by the central line. The wind coverage can be calculated by summing up all the percentages.

BASIC RUNWAY LENGTH

It is the length of runway under the following assumed conditions at the airport.

1. Airport altitude is at sea level.

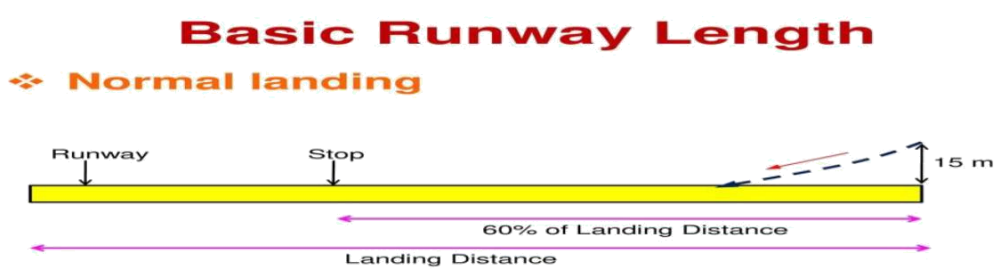
2. Temperature at the airport is standard 15ºc

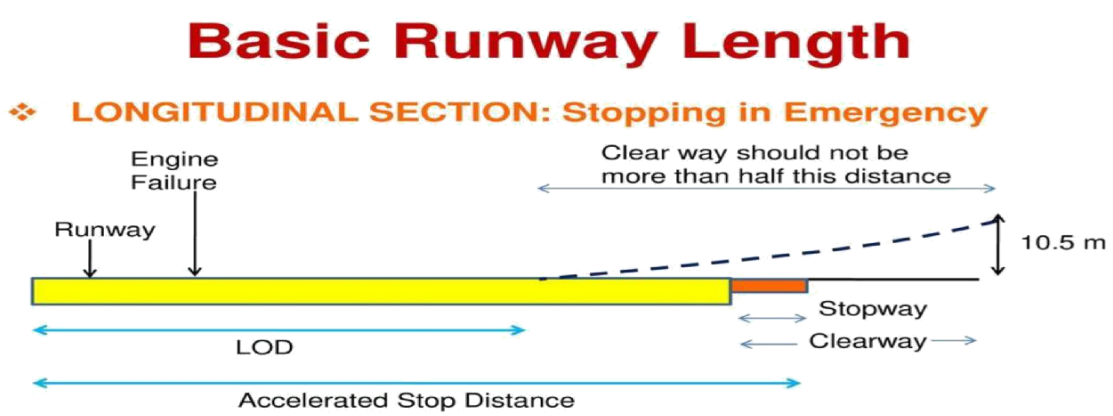
3. Runway is leveled in the longitudinal direction.

4. No wind is blowing on runway

5. Aircraft is loaded to its full loading capacity.

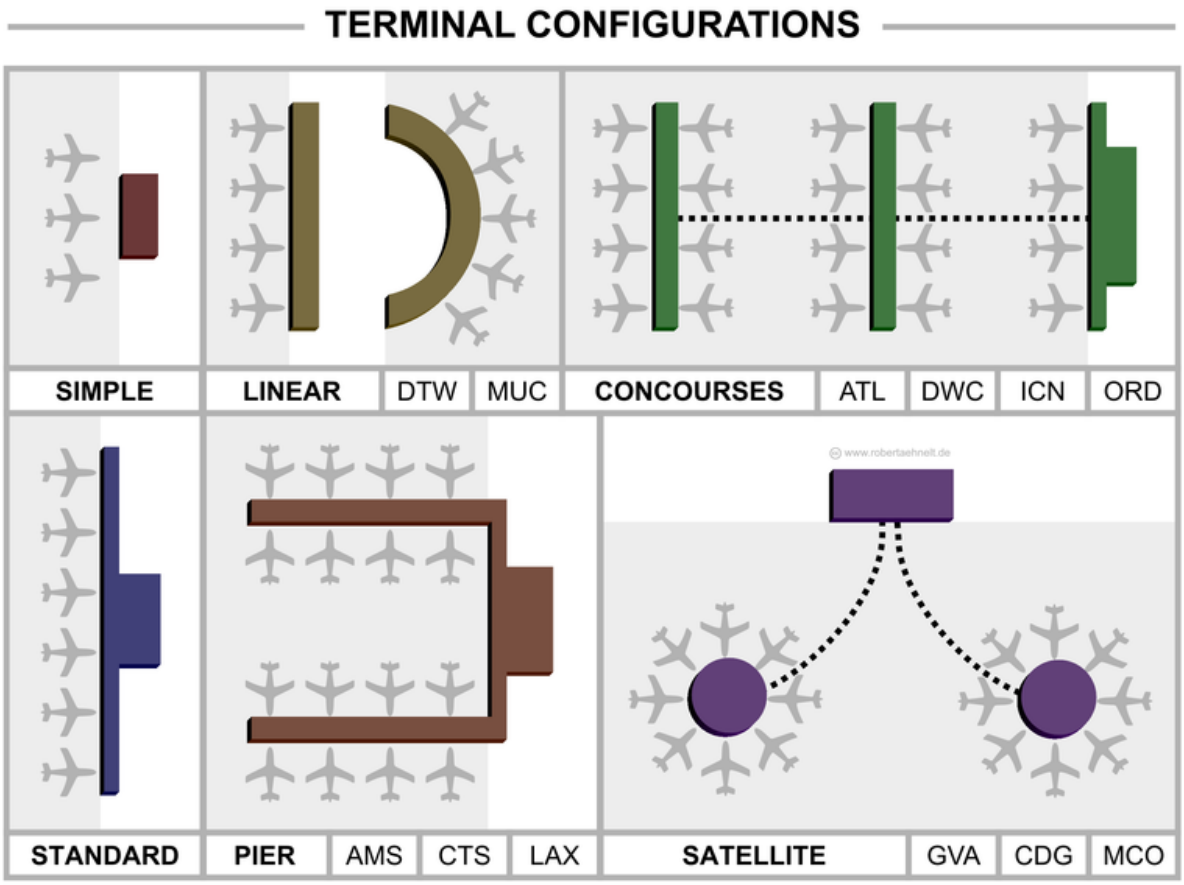
6. There is no wind blowing en route to the destination.

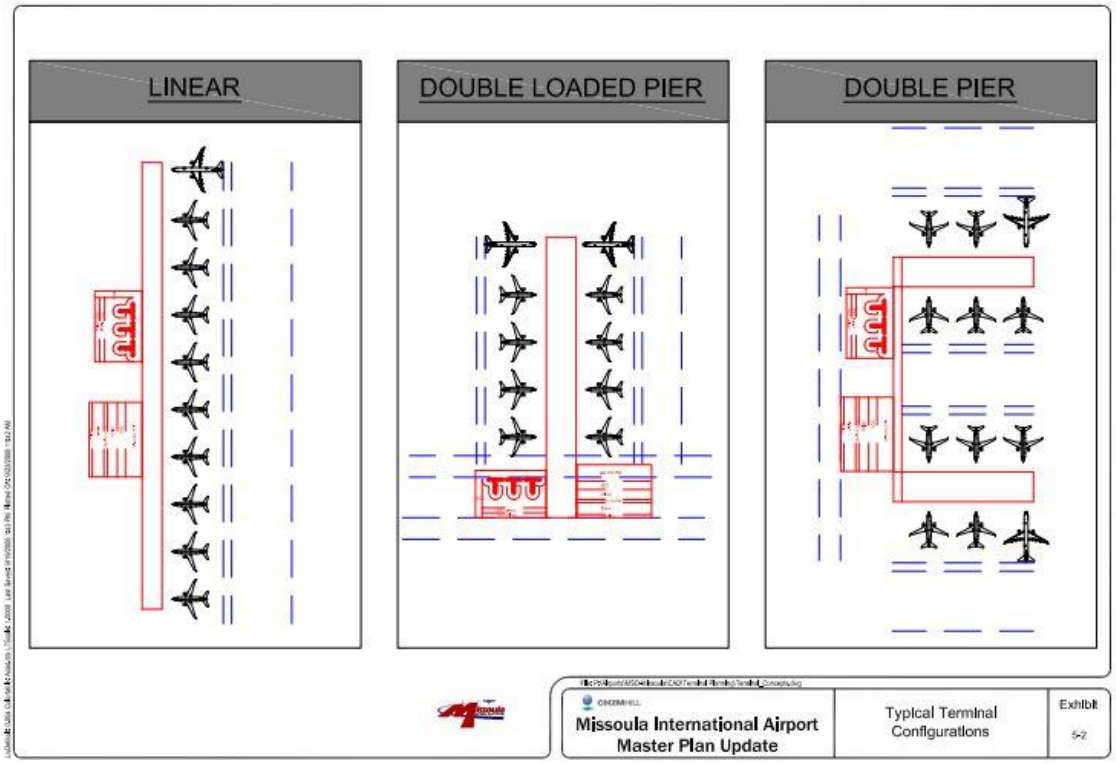




TERMINAL AREA

An **airport terminal** is a building at an **airport** where passengers transfer between ground transportation and the facilities that allow them to board and disembark from aircraft. Within the **terminal**, passengers purchase tickets, transfer their luggage, and go through security.




LINEAR
DOUBLE LOADED PIER
DOUBLE PIER
Missoula International Airport
Master Plan Update
Typical Terminal
Configurations
Exhibit
5-2