CHAPTER II

LITERATURE REVIEW

2.1 Aerodrome

Based on ICAO (International Civil Aviation Organization) Annex 14, Aerodrome can be defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

According to Horonjeff et al. (2010), Aerodrome have another meaning that is a number of runway, and locations of the apron toward to the runway. Traffic volume affect the number of runway, while the direction of the runway depended on the direction of the wind and wide area for the aerodrome needed. The terminal building is for the passenger and should be designed to ease the passenger movement heading to the runway.

Based on ICAO (International Civil Aviation Organization) Annex 14, there are the reference code for aerodrome design manual as the guidance with the simple method for describe the specification for the aerodrome classification for designing the facility for the aerodrome corresponding to the aircraft that operating in the airport. The codes consist of two element that related to the characteristic and dimension of the aircraft. The first element is the number based on length of runway and second element is the letter based on the wingspan and gear wheel span for the aircraft.

Dimension of the aerodrome affected by several factors such as characteristic and types of the aircraft that operating at the airport. The numbers of passenger, meteorology condition in the area, elevation of the airport from the sea level (MSL) (Dewi Anastasia.I.W. 2014).

Based on Nugraha (2016), there are several facilities that needed for support the activity in the airport such as:

a. Basic facility

1. Airside consist of one or more of *runway* that connected to *taxiway* and for *apron* and for fulfill the operating requirement for moving aircraft on the ground.
2. Landside consist of terminal building, cargo building, operating building, and another support building that needs for the airport.
3. Communication facilities consist of *Aeronautical Fixed Service* (AFS) and *Aeronautical Mobile Service* (AMS).
4. Navigation Facilities is the equipment that installed in the ground as the radio transmitter. The facilities consist of Non Directional Beacon (NDB), *Instrument Landing System* (ILS), *Very High Frequency Omni Range* (VOR) and D*istance Measuring Equipment* (DME).
5. Supported equipment facilities is the facility such as lightings is installation for support the landing and take of in the runway for aircraft. There are consist of *hazard beacon, obstruction light, rotating beacon, runway edge*

light, approach light, precision approach path indicator (PAPI) and another lighting support.

The basic facilities, the aviation communication facilities, aviation navigation facilities, and support equipment facilities for visual navigation is the part of the safety facilities.

b. Utility facilities
    1. Electricity facilities.
    2. Communication facilities.
    3. Clean water facilities.
    4. Waste treatment facilities.
c. Airport support facilities
    1. Hotel facilities.
    2. Restaurant and store facilities.
    3. Parking place facilities.
    4. Maintenance facilities.

To help to design of airport more easily and to fulfill the require standard. There guidance that provided by FAA and ICAO, for design the wide, gradient, separation for runway, taxiway, and another factor from aircraft operation based on the condition of the aircraft and pilot ability and weather. (Horonjeff et al. 2010).

In the analysis research for this proposal, the object of research focusing on the *airside* facilities for Kuabang Kao Airport that consist of *runway, taxiway*, and *apron.*

2.2 Runway

Based on ICAO (*International Civil Aviation Organization*) *Aerodrome Design Manual Part* 1: Runways (2006), runway can be defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft. Many factors affect the determination of the siting, orientation and number of runways. The more important factors are:

a. Weather, in particular the runway or aerodrome usability factor, as determined by wind distribution, and the occurrence of localized fogs.
b. Topography of the aerodrome site and its surroundings.
c. Type and amount of air traffic to be served, including air traffic control aspects.
d. Aircraft performance considerations.

According to Horonjeff et al. (2010) the standard configuration consideration basically used for runway as the basic. The basic configuration there are:

a. Single runways

In this configuration is the simple one compared to another configuration. For this type of runway in VFR condition the capacity of the runway is 50 to 100 operational per hour. And for type IFR the capacity is

decreasing from 20 to 70 operations. It depends on the combination types of aircraft and navigational aids.

b. Parallel runways

This capacity of configuration is depended on the number of runway and range of the runway. Number of parallel runway often found on two parallel runways. or four parallel runways. There is low possibility the number of runway can be more then fours runway because need more land area and the difficulty of organizing the traffic system for runway more than four. For this system need more airspace and distance of runway can be divided to three, there are:

1. Close parallel runway. The distance of this runway can be 213 m (700 ft) to 1067 m (3500 ft). the capacity for this type of runway is 50 to 60 movement for IFR.
2. Intermediate parallel runway. this type has distance from 1067 m (3500 ft) to 1524 m (5000 ft). the capacity for this type of runway is 60 to 75 movement for IFR.
3. Far parallel runway. this type the distance can be divided to 1310 m (4100 ft) or can be more. The capacity for this type of runway there are 100 to 125 movement for IFR condition.

c. Intersecting runways

This type of runway consists of two parallel runways with distance (213 m – 762 m) and the exit taxiway with adequate. Both runway can be used for mixed flights. But, for the runway that located far away from the terminal building is used for arrival and near one can be used for departure. And the requirement for both runway not less than 305 m if this runway for large aircraft. Taxiway that parallel to the both runways to increasing the capacity. The benefit from this configuration is to increase the capacity from the IFR condition with less land needed.

d. Open V runways

Runways in different directions which do not intersect are referred to as open-V runways. Like intersecting runways, open-V runways revert to a single runway when winds are strong from one direction. When the winds are light, both runways may be used simultaneously. The strategy which yields the highest capacity is when operations are away from the V and this is referred to as a diverging pattern. In VFR the hourly capacity for this strategy ranges from 60 to 180 operations per hour, and in IFR the corresponding capacity is from 50 to 80 operations per hour.

Based on ICAO (International Civil Aviation Organization) Aerodrome Design Manual Part 1: Runway. (2006). There are same runways system geometric specification, such as:

a. The runway *structural pavement* supports the aircraft with respect to structural load, maneuverability, control, stability, and other operational and dimensional criteria.
b. The *shoulder adjacent* to the edges of the structural pavement resists jet blast erosion and accommodates maintenance and emergency equipment.
c. The *blast pad* is an area designed to prevent erosion of the surfaces adjacent to the ends of runways due to jet blast or propeller wash.
d. The *runway safety area* (RSA) is an area surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway. It should be free of objects except for objects that are required to be located in the runway safety area because of their function.
e. The *runway object free area* (OFA) is defined by the FAA as a two-dimensional ground area surrounding the runway which must be clear of parked aircraft and objects other than those whose location is fixed by function.
f. The *runway obstacle free zone* (OFZ) is a defined volume of airspace centered above the runway which supports the transition between ground and airborne operations. The FAA specifies this as the airspace above a surface whose

elevation is the same as that of the nearest point on the runway centerline and extending 200 ft beyond each end of the runway.

g. The *inner approach obstacle free zone*, which applies only to runways with approach lighting systems, is the airspace above a surface centered on the extended runway centerline beginning 200 ft beyond the runway threshold at the same elevation as the runway threshold and extending 200 ft beyond the last light unit on the approach lighting system.

h. The *inner transitional obstacle free zone*, which applies only to precision instrument runways, is defined by the FAA as the volume of airspace along the sides of the runway and the inner approach obstacle-free zone. The surface slopes at the rate of 3 horizontal to 1 vertical out from the edge of the runway obstacle-free zone and the inner approach obstacle-free zone until it reaches a height of 150 ft above the established airport elevation.

i. The runway *protection zone* (RPZ) is an area on the ground used to enhance the protection of people and objects near the runway approach.

The orientation of a runway is defined by the direction, relative to magnetic north, of the operations performed by aircraft on the runway. Typically, but not always, runways are oriented in such a manner that they may be used in either direction. It is less preferred to orient a runway in such a way that operating in one direction is precluded, normally due to nearby obstacles. When landing and taking off, aircraft are able to maneuver on a runway as long as the wind component at right angles to the direction of travel, the crosswind component, is not excessive.

The FAA recommends that runways should be oriented so that aircraft may be landed at least 95 percent of the time with allowable crosswind components not exceeding specified limits based upon the airport reference code associated with the critical aircraft that has the shortest wingspan or slowest approach speed. When the wind coverage is less than 95 percent a crosswind runway is recommended.

Once the maximum permissible crosswind component is selected, the most desirable direction of runways for wind coverage can be determined by examination of the average wind characteristics at the airport under the following conditions:

a. The entire wind coverage regardless of visibility or cloud ceiling.
b. Wind conditions when the ceiling is at least 1000 ft and the visibility is at least 3 miles.
c. Wind conditions when ceiling is between 200 and 1000 ft and/or the visibility is between ½ and 3 miles.

The orientation can be determined by using computer program or using method of wind rose. A standard wind rose consists of a series of concentric circles cut by radial lines using polar coordinate graph paper. The radial lines are drawn to the scale of the wind magnitude such that the area between each pair of successive lines is centered on the wind direction. (Hoel et al. 2008).

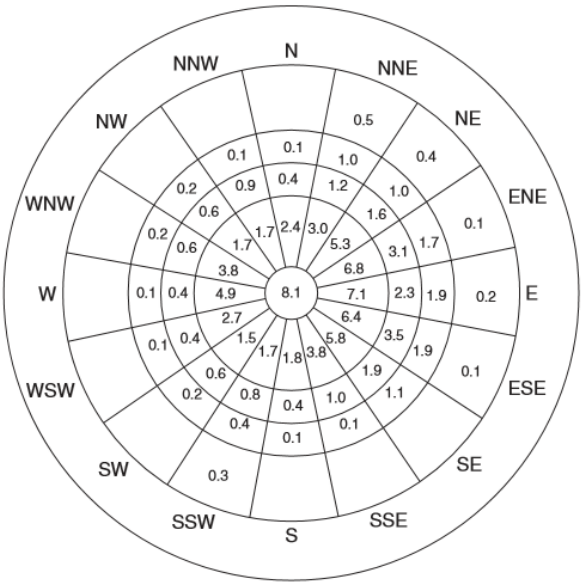

Figure 2.1 *Wind Rose Diagram*

Source: *Horonjeff et al, 2010*

2.3 Taxiway

Taxiways are defined paths on the airfield surface which are established for the taxiing of aircraft and are intended to provide a linkage between one part of the airfield and another. The term “dual parallel taxiways” refers to two taxiways parallel to each other on which airplanes can taxi in opposite directions. An apron taxiway is a taxiway located usually on the periphery of an apron intended to provide a through taxi route across the apron. A taxi lane is a portion of the aircraft parking area used for access between the taxiways and the aircraft parking positions.

ICAO defines an aircraft stand taxi lane as a portion of the apron intended to provide access to the aircraft stands only. In order to provide a margin of safety in the

airport operating areas, the traffic ways must be separated sufficiently from each other and from adjacent obstructions. Minimum separations between the centerlines of taxiways, between the centerlines of taxiways and taxi lanes, and between taxiways and taxi lanes and objects are specified in order that aircraft may safely maneuver on the airfield.

Based on ICAO (International Civil Aviation Organization) Annex 14, there are several types of taxiway, such as:

a. Aircraft stand taxiway

   This is the part of apron that for the taxiway design for purpose to provide access to the aircraft stands.

b. Apron taxiway

   This the supply the access for traverse the apron.

c. Parallel taxiway

   Is the taxiway that parallel to the runway.

d. Exit taxiway

   This the taxiway that connected to the runway as the access for entering or exit the runways.

e. Rapid exit taxiway

Rapid exit taxiway known as high speed exit taxiway, that to allow aircraft to leave the runway at higher speeds. This allows the aircraft to vacate the runway quicker, permitting another to land or take off in a shorter interval of time.

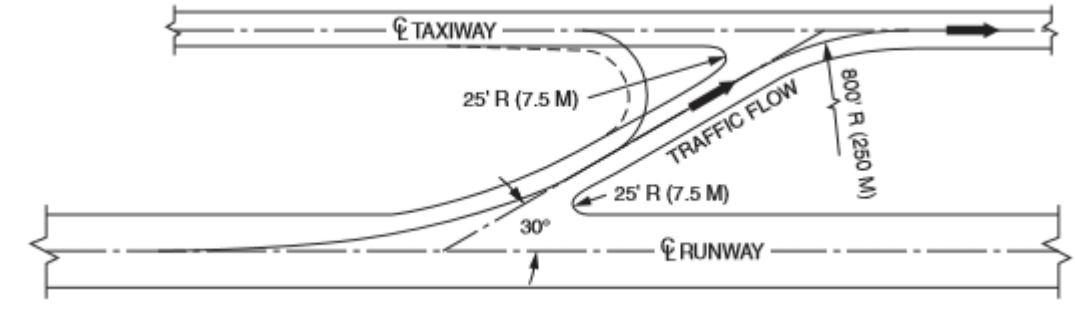

Figure 2.2 *Rapid exit taxiway*

Source: *Horonjeff et al, 2010*

2.4 Apron

Apron is the areas are used as storage areas for aircraft prior to takeoff. They are designed so that one aircraft can bypass another whenever this is necessary. The apron also provides for a trailing aircraft to bypass a leading aircraft in case the takeoff clearance of the latter must be delayed for one reason or another, or if it experiences some malfunction.

The important design criteria are to provide adequate space for aircraft to maneuver easily onto the runway irrespective of the position of adjacent aircraft on the apron and to provide sufficient room for an aircraft to bypass parked aircraft on the apron. There are also that some types of apron, such as:

a. Terminal apron

On the terminal apron or ramp are sized for the geometric properties of a given design aircraft, including wingspan, fuselage length and turning radii, and for the requirements for aircraft access by the vehicles servicing the aircraft at the gates.

b. Cargo apron

This type of apron is the parking area for cargo aircraft for loading and unloading the carrier.

c. Parking apron

This is the apron to provide the parking area for aircraft that does not have schedule to flight.

d. Service and hangar apron

Service and hangar apron is an apron where maintenance and repairing of an aircraft is carried out under a hanger.