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Aircraft parking stands: proposed model for Indonesian airports

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Abstract

The purpose in this study is to analyze the optimization of aircraft parking stands, and proposed model for apron development in near future at Sultan Hasanuddin International Airport (SHIA) to achieve safety on airport operation activities. The study was conducted by collecting and analyzing data. The data were based on field survey, interviews, discussion with airport authority, official government, etc. and also from various agencies. Analytical tools applied were: regression analysis, to forecasts passenger and aircraft movements; and JICA formulas, to analyze the aircraft movement at peak hours, and number of aircraft parking stands for short, medium, and long terms period. The conclusion are: (a) the optimizing level on the apron area, especially at peak hours at SHIA depends on the aircraft service time, (b) the ability to serve the aircrafts on the apron area at peak hours as many as 17 to 22 aircraft parking stands, and need additional space as much as 24,431m^2, 39,216 m^2, and 52,354 m^2 in 2015, 2020 and 2025 respectively, (c) requirement to develop/introduce other aircraft parking stands model, (d) proposed the new apron or aircraft parking stands model as known as pier or satellite models to anticipate the increasing number of passenger and aircraft movements in the near future; while the recommendation can be included that the use of service time as effectively and efficiently at the apron area could provide better service for passengers, aircrafts.

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Keywords: Airport; apron; aircraft parking stands

1. Introduction

According to Annex 14 of ICAO (International Civil Aviation Organization), airport is a defined of an area on land or water (including any buildings, installations and equipment), intended in a whole or in a part for the arrival,

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departure and movement of aircrafts[1]. Airport planning guideline in detail is issued by ICAO and FAA (Federal Aviation Administration). In Indonesia, it is covered by the rules of the Indonesian Government Regulation No. 70, 2001 on Airport System and Transportation Decree KM 44, 2002 on National Order of Airport and CASR 139 for Aerodrome Area. Airport has two distinct areas, namely landside and airside. On the airside comprise several important parts, i.e. runway, taxiway and apron. Runway length usually depends on the size of aircraft served.

Sultan Hasanuddin International Airport (SHIA) is a gateway airport in eastern Indonesia and has been supporting and developing the economy, trade, industry and tourism. This airport is located 22 km from the city of Makassar, South Sulawesi Province, Indonesia. The number of passengers and aircrafts is increasing from year to year. The airport went through a process of expansion and development started in 2004 and completed in 2009. Passenger terminal area is approximately 10,815 m² wide with the capacity is 7 million passengers per year. Meanwhile, apron area is 78,800 m² and capacity is 17 aircraft parking stands. Runway length is 3,500 meter and width is 45 meter. Several problems occurred that terminal merely has 6 gates with avio-bridge. It cannot cope with number of aircraft parking stand using avio-bridge. Moreover, loading and unloading passengers should take bus from terminal to the aircrafts at peak hours[2,3]. The purpose of this study is to analyze the optimization of aircraft parking stands, and proposed model for apron development in the near future to achieve safety on airport operation activities.

2. Airport Facilities

Commonly, international airports have more than one runway to anticipate the increase traffic growth. Aircraft parking at apron is close to the terminal building, taxiway is connecting runway and apron. On the landside area consists of several parts, i.e., access road, curbside, parking of vehicles, terminal and its supporting facilities. Airport terminal is a place for passengers departing, arriving and transit in which there are x-ray, check-in counters; ciq (custom-immigration-quarantine) for international airport; concourse, waiting room as well as various facilities for passengers' comfort, avio-bridge; and so on.

2.1. Apron

Aircraft parking stand is aircraft parking on the apron for conducting ground services activities, accommodate more than one aircraft, perform manoeuvre safely and set through the configuration model. It depends on the size of area and number of aircrafts being served.

Type of apron according to Horonjeff/McKelvey, namely: (1) terminal apron, designed for manoeuvre and aircraft parking, easily connected to the passenger terminal facilities, used to refuel aircraft and aircraft maintenance and to load and unload goods; (2) cargo apron, used to load and unload for cargo aircraft carrying goods, cargo, mail and others without passengers; (3) parking apron, used for aircraft parking for a long period of time, should be placed as close as possible to the terminal apron; (4) service and hangar apron, is an open space to perform maintenance and repairs to the aircraft, which is located adjacent to the maintenance hangar[4].

An apron will accommodate number of aircrafts according to the calculation of the amount of each type of aircraft movements during peak hours.

2.2. Slope Requirements

Apron should be required to have sufficient slope, such that no pond of water on the apron surface, where maximum slope is 1%. The aircraft fuel loading area should be half percent of apron slope to the aircraft axis transverse to ensure the accuracy of fuel measurements. The apron slope should stay away from the terminal building, especially in the fuel filling area[5,6].

2.3. Aircraft Parking Stand Model

Aircraft parking stand consists of several models, namely: (1) linear model, gives direct entrance from the front yard to the aircraft gate position, provides high level of flexibility for terminal development, (2) pier(finger) model,

has a meeting point with aircrafts along the pier that extends from the main terminal area, where the aircrafts positions around the pier axis in parallel or nose-in aircrafts position, (3) satellite model, allowing for apron space free from distractions, aircrafts parking patterns is in a dense position, separate from terminal and achieved through the connector at the bottom or on the ground, and aircraft parking is in circles position, (4) open apron/transporter model, aircraft parked in front of the terminal with more than one parking rows, the advantage is taxiing distance from runway to apron could be reduced[4,7].

3. Methodology

Data were collected from field survey and interviews, consisting aircraft activities on the apron, types of aircraft and passenger handling from apron to the terminal or vice versa, and service time, while several data consist of both number of departing and arriving passengers, and based on air traffic statistics.

Survey and interviews were finished during the week based on the characteristics of SHIA activities. The research was carried out on the apron area and the AMC (Apron Monitoring Control).

In analyzing data, there are 9 stages of analysis, as follows: (1) analysis of apron parameter and apron capacity; (2) daily aircraft movement; (3) aircraft movement at peak hours; (4) annual aircraft movement; (5) number of aircrafts parked on apron; (6) time of parking aircraft; (7) aircraft backup/reserves; (8) forecasting model of passenger and aircraft movements; and(9) aircraft parking stands analysis for short, medium and long terms period.

Analyzing the passenger and aircraft movements at peak hours need to define the coefficient value of traffic demand during peak hours (Cp). In Indonesia, according to Japan International Corporation Agency (JICA)[8,9], the aircraft movement formula as follows:

$$Md = My / 365 \tag{1}$$

$$Cp = 1.38 / \sqrt{Md} \tag{2}$$

where: Md = daily aircraft movement; My = annual aircraft movement; Cp = peak hour factor; Mp = aircraft movement at peak hour (Cp x Md).

$$K = (NxT / 60) + A \tag{3}$$

where: K = number of aircraft that can be parked on the apron; N = number of aircraft movement at peak hour; T = time of occupied aircraft at parking area (30-60 minutes); A = aircraft backup.

An airport should be developed based on forecast. From the forecast, evaluation of the effectiveness of various airport facilities can be stated. In general, forecasts are needed for short-term, medium and long-term or roughly 5 years, 10 years and 20 years, respectively. A prediction or forecast is able to estimate the number of data as accurately as possible, or estimate the failure as small as possible.

4. Results and Discussions

4.1. Apron Condition at SHIA

The apron of SHIA is 78,800 m², with length of 462.31 m² and width of 170.45 m². Capacity is as many as 17 aircraft parking stands. The biggest aircraft is an aircraft of type D (38 - < 52 m), and clearance between aircrafts is 7.5m with 6 avio-bridge.

4.2. Passengers and Aircrafts Movements

The passenger growth, both departing and arriving, continues to increase from year to year with average of 11.92%. In last 3 years, the passenger growth both departing and arriving were 5.77%, 8.826% and 21.16% respectively. While, the aircraft average growth both departing and arriving has similar way, increasing by 9.41%. In

last 3 years, the aircraft growth both departing and arriving were 3.00%, 6.27% and 18.97% respectively.

The forecasting of passengers and aircrafts movement could be seen on table 1 and table 2 as below:

Table 1. Passenger movement

Passenger movement	2015	2020	2025
Departing passenger (m)	3.933.875	5.432.966	6.932.058
Passenger growth (%)	4.89	6.75	8.61
Arriving passenger (m)	3.620.498	5.016.330	6.412.163
Passenger growth (%)	4.88	6.76	8.64

Source: Analysis Results

Based on Table 1, the passenger movement is increasing continuously by around 2% every 5 years. It shows the capacity of facilities of terminal and elevation of the number of aircrafts should be well prepared to anticipate the growth of passengers.

Table 2. Aircraft movement

Aircraft movement	2015	2020	2025
Departing aircraft (n)	43.153	55.884	68.255
Aircraft growth (%)	4.98	6.40	7.82
Arriving aircraft (m)	46.891	62.054	77.218
Aircraft growth (%)	4.95	6.55	8.15

Source: Analysis Results

The growth of aircraft movement indicates that requirement of replenishment of aircraft parking stands is a necessity. Planning of airside including runway, taxiway and apron will be well-suited with the information of existing and forecasting of aircraft movement as in Table 2.

Table 3. Number of aircrafts at peak hours

Variables	2015	2020	2025
Peak hours factor (Cp)	0.088	0.077	0.069
Daily aircraft movement (Md)	247.681	323.118	398.555
Aircraft movement at peak hours (n)	22	25	28
Annual aircraft movement (My)	90.404	117,938	145.473

Source: Analysis Results

The projection result as in Table 3 above for aircraft movements (departing and arriving) during peak hours in 2015, 2020 and 2025 are 22, 25 and 28 aircrafts respectively, which will be applied to analyze the needs and requirements for aircraft parking stands.

4.3. Forecasting of Apron Area

Forecasting on apron area in 2015, 2020 and 2025 are explained in the next tables. Analysis of apron needs links to Table 4 and Table 5 referring to analysis of apron area as both in below.

Table 4. Analysis of apron needs

Variables	2015	2020	2025
Number of aircraft movement at peak hours (n)	22	25	28
Aircraft parking time (30-60 minutes) (T)	45	45	45
Aircraft reserves (A)	1	1	1
Number of parked aircraft (n)	17	20	22

Source: Analysis Results

Table 5. Analysis of apron area

Year	My	Md	K	Area (m^2)	Extension Area (m^2)
2015	90.404	247.681	23	103.231	24.431
2020	117.938	323.118	26	118.016	39.216
2025	145.473	398.555	29	131.154	52.354

Source: Analysis Results

Based on the results obtained in Table 4 and 5, it shows that apron area in 2015 requires as many as 17 parking stands with an apron area of 103,231 m^2. The apron wide at existing conditions is 78,800 m^2, requiring additional space as much as 24,431 m^2 to accommodate aircraft parking stands at peak hours. In 2020 requires as many as 20 aircraft parking stands with an apron area 118,016 m^2, requiring additional space as much as 39,216 m^2 to accommodate aircraft parking stands at peak hours. And in 2025 requires as many as 22 aircraft parking stands with apron wide is 131,154 m^2, needs additional space as much as 52,354 m^2.

4.4. Proposed Model for Indonesian Airport

Commonly, in Indonesian airports, especially in SHIA, they applied variations of passenger handling, i.e. linear or open apron aircraft parking stands models. It connects passengers from terminal via avio-bridge to the aircrafts, but at peak hours, passengers are transported from terminal to the aircrafts by bus. This way shows lack of apron optimizing and it is not comfortable for passengers since width of terminal in linear/open apron model is limited. It cannot cope with growth of aircrafts, beyond the number of gate terminal (6) and avio-bridge (6) availability. It is proposed that the new aircraft parking stands model for SHIA will be pier or satellites models. It is chosen in order to anticipate the increasing number of passenger and aircraft movements in the near future since pier or satellite models provide decentralized holding areas for passengers adjacent to their gates, no surface interference and aircraft gates can be sited all around the satellites.

5. Conclusions and Recommendations

As conclusion can be explained as follows: (a) the optimizing level on the apron area, especially at peak hours at SHIA depends on the aircraft service time, (b) the ability to serve the aircrafts on the apron area at peak hours with the service time of 45 minutes as many as 17 to 22 aircraft parking stands, and require additional space as much as 24,431m^2, 39,216 m^2 and 52,354 m^2 in 2015, 2020 and 2025 respectively, (c) need to develop/introduce other aircraft parking stands models, (d) propose new apron or aircraft parking stands model as known as pier or satellite models at SHIA to anticipate the increasing number of passenger and aircraft movements in the near future; while the recommendation can be included that the use of service time as effectively and efficiently at the apron area could provide better service for passenger, airlines, and so forth. On the other hand, it needs developing aircraft hangars for aircrafts services and maintenance requirement. The aircrafts do not have to occupy at the apron area in a long time/queuing time that have an impact for aircraft stands in the apron.

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