The Development of Airport Curbside Performance at Sultan Hasanuddin International Airport, Makassar

Pengembangan Kinerja Curbside Bandara Intenasional Sultan Hasanuddin, Makasar

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ABSTRACT

Airport curbside is a gateway airport which connects the airport terminal building and land transport system. Airport curbside areas serve to provide (a) loading and unloading areas for vehicles and (b) circulation lanes for vehicles approaching, departing, arriving and traveling adjacent to the curbside areas. Easy access to an airport is an important factor that determines the overall success of the airport. There are problems almost at every curbside airport in Indonesia especially at Sultan Hasanuddin International Airport as Gateway Airport of East Indonesia, generally caused by the lack of curbside operations management. The length of departure and arrival curbside at Sultan Hasanuddin International Airport are 215 m and 107 m respectively. The purpose of this study was to analyze the existing and forecast the airport curbside performance, level of service and create solutions to the problem in order enhance the curbside services for the near future and improve and develop the vehicles circulation at the airport landside area. The study was conducted by collecting data at Sultan Hasanuddin International Airport. The data used are primary and secondary data. The primary data was based on field survey at Sultan Hasanuddin International Airport, interviews and discussions with airport authority, official government and passengers, while secondary data is based on data collected from various agencies, namely the Directorate General of Transport Department, the Statistic Central Bureau, and PT. Angkasa Pura 1. Analytical tools used to forecast the flows of passengers and aircrafts was The Regression Analysis (SPSS program 11.0). The analysis was based on Directorate General of Transport Department rules and the level of service and curbside performance based on IATA standards. The findings and recommendations of the study can be summarized as follows: i) curbside length at the existing condition for departure and arrival curbside are still adequate, while for the several years ahead in 2013 is still adequate for curbside departure and not adequate for curbside arrival where the length of the required curbside is 143 m, ii) to anticipate the delay of vehicles circulations at the curbside area, vehicles can not stop more than five minutes or parking along the curbside area, iii) the need to construct the pedestrian way from terminal to parking area or vice-versa - provided with eco-friendly landscape, iv) vehicles parked at the departure and arrival curbsides must be moved to the parking area to accelerate the vehicles circulation flows, v) implement strict regulations, and vi) designers of airports should plan through expansion of existing curbside facilities in the long-term planning.
Keywords: Airport, Curbside Performance, Level of Service (LoS)

ABSTRAK

Curbside bandara adalah jalur bandara yang menghubungkan bangunan terminal dan sistem trnasportasi darat. Curbside bandara digunakan untuk naik dan turunnya kendaraan dan jalur sirkulasi untuk kendaraan menuju, menunggalkan, kedatangan, dan perjalanan yang berbatasan langsung dengan curbside. Akses yang mudah menuju bandara adalah faktor penting yang mempengaruhi keberhasilan bandara secara keseluruhan. Permasalahan hampir di seluruh curbside bandara di Indoensia terutama Bandara Internasional Sultan Hasanuddin sebagai gerbang bandara di wilayah Indonesia Timur, umum-nya disebabkan kurangnya manajemen operasional curbside. Panjang keberangkatan dan kedatangan curbside di Bandara Internasional Sultan Hasanuddin adalah 215 m dan 107 m. Tujuan penelitian ini adalah menganalisa kinerja curbside yang ada dan memperkirakannya pada masa yang akandatang, tingkat pelayanan, dan menemukan solusiuntuk permasalahan agar pelayanan curbside menjadi meningkatu untuk jangka pendek dan mengembangkan sirkulasi kendaraan pada area darat bandara. Penenlitian dilakukan dengan mengumpulkan data di Bandara Internasional Sultan Hasanuddin. Data yang dipergunakan adalah data primer dan sekunder. Data primer didapatkan dari survey lapangan pada Bandara Internasional Sultan Hasanuddin, wawancara, diskusi dengan pengelola bandara, pemerintah dan penumpang, sedangkan data sekunder berasal dari beberapa lembaga, yaitu Dirjen Perhubungan dan Transportasi, Biro Pusat Statistik, dan PT. Angkasa Pura 1. Untuk analisis perkiraan aliran penumpang dan pesawat menggunakan Analisis Regresi (program SPSS 11.0). Analisis didasarkan pada peraturan Dirjen Perhubungan dan Transportasi, tingkat pelayanan dan kinerja curbside berdasrkan standar IATA. Hasil dan rekomendasi dari penelitian ini dapt disimpulkan sebagai berikut: i) panjang curbside yang ada untuk keberangkatan dan kedatangan masih mencukupi, sedangkan untuk tahun 2013 masih mencukupi untuk keberangkatan, dan tidak layak lagi untuk kedatangan, dimana kebutuhan panjang curbside adalah 143 m, ii) untuk mengantisipasi penundaan sirkulasi kendaraan, kendaraan tidak boleh berhenti lebih dari lima menit atau parkir di sepnajang curbside, iii) dibutuhkan pembangunan jalur pejalan kaki dari terminal menuju area parkir dan sebaliknya dengan konsep eco-friendly, iv) kendaraan yang parkir di curbside keberangkatan dan kedatangan harus bergerak ke area parkir untuk mempercepat aliran kendaraan, v) melaksanakan peraturan yang ketat, vi) perencana bandara harus mendesain curbside untuk kebutuhan jangka panjang.
Kata-kata Kunci: Bandara, kinerja curbside, tingkat pelayanan (LoS)

BACKGROUND

Sultan Hasanuddin International Airport, Makassar in South Sulawesi Province is the gateway airport and as a transit point for air transport passenger flows from west Indonesia to east Indonesia and vice versa. Growth in number of passengers and flights through this airport increased rapidly from year to year, especially after the opening of the open sky policy and cheap ticket competition among several airlines. Increasing number of passenger and aircraft movements affect the accessibility of vehicles or modes of ground transportation to and from the airport, the flows of passengers and visitors at the terminal, and aircraft movements at

runway, taxiway and apron. This also affects the performance airport curbside access at Sultan Hasanuddin International Airport as a meeting point between the terminal building and ground transportation systems for dropping-off and picking-up passengers at the terminal building. The purpose of this study was to analyze the existing and forecast the airport curbside performance, level of service and create solutions to the problem in order enhance the curbside services for the near future and improve and develop the vehicles circulation at the airport landside area.

CONCEPT OF AIRPORT

The airport is used for landing and takeoff of aircrafts, drop and pick-up passengers and/or loading and unloading cargo and/or post and equipped with flight safety facilities and as a place of transfer between modes of transportation (Adisasmita, 2007). Airports are divided into two main parts: the airside and the landside facilities. Terminal buildings became an intermediary between the two parts of it. In this system the characteristics of both land and air vehicles, has a big influence in planning. Passengers and cargoes concerned about the time spent out from the origin to their destination, and not only by the duration of air travel. For that reason, the access or entrance to the airport is an important thing that should be considered in planning (Evrianti dan Widiastuti., 2005).

PASSENGER TERMINAL SYSTEM, ACCESS INTERFACE AND CURBSIDE

Passenger teminal system is the primary liaison between the entrance road to the airplane in order to process the passengers who begin or end an air travel and to transport luggage and passengers to and from aircraft. Access interface consists of a terminal yard such as parking facilities and connecting road which allows passengers, visitors and goods to enter and exit the terminal. Curbside is a meeting point between the terminal building and the land transport system, which serves as a place to drop-off or pick-up passengers. The formula of departure and arrival curbside are as follows:

Departure Curbside :

$$CL = \frac{(PHP - DEP) \times VL \times DT}{(P/V) \times ST_{(60menit)}} \quad (1)$$

Arrival Curbside:

$$CL = \frac{(PHP - ARR) \times VL \times DT}{(P/V) \times ST_{(60menit)}} \quad (2)$$

Where:

CL = Curbside length
PHP = Peak hour passanger
ARR = Arriving passanger
DEP = Departing passanger
VL = Vehicle length
DT = Dwell time (average time to drop-off/pick-up passenger)
P = Person/pax (number of person/passenger)
V = Vehicle, ST = Service time (in 60 minutes).

The use of general instructions for curbside can be seen in Table 1 below.

Table 1. General Instructions Use for Curbside

No	Vehicle Type	Vehicle Length (m)	Charging Time (min)
1	Private Car	7,62	2 - 4
2	Taxi	6,09	2 - 4
3	Bus	15,24	15- 25

Source: Horonjeff & McKelvey, 1993.

LEVEL OF SERVICE

The explanation of the standard categories of service level based on the IATA (International Air Transport Association) as stipulated in the SKEP/100/XI/1983 about airport rules and regulations including Level of Service, where given a coefficient comparison at each level/standard of service quality from level A to F. Curbside as access facilities to drop-off and pick-up passengers who will go and leave the terminal is one of the airport facilities which are very sensitive because it involves direct service to the users of airport services, both to passengers and airport partners. The Category of level of service (LOS) A is the best and F is the worst. The level of service quality C is recommended as the minimum limit of airport terminal activities because this LOS as the level of good service quality. The standard service level categories based on the IATA (International Air Transport Association) (Ashford & Wright, 1992) is shown in the Table 2.

Table 2. The standard service level categories based on the IATA (International Air Transport Association)

No	LoS	Coefficient of Comparison	Condition
1	A	1	The level of perfect quality, no queue runs, perfect comfort level
2	B	0,8	High levels of service quality, smooth condition of current circulation, very few of the queue waiting passengers, a very good comfort level
3	C	0,6	Better quality of service levels, circulation is stable, rows of passengers waiting queue are enough, a good comfort level
4	D	0,4	Service level or quality is good enough, not stable circulatory condition, the condition queue of passengers can be accommodated in a short period, the comfort level is good enough
5	E	0,2	Quality level of service less, unstable circulatory condition, the condition of the passenger queue can not be added, less comfort level
6	F	< 0,2	Level of service quality is less good or not acceptable, circulatory conditions caused many problems, the condition of passenger queue can not be handled, less comfort level

Souce: Ashford & Wright, 1992.

FORECASTING MODEL

An airport plan should be developed on the basis of forecasts. From the demand forecasts to set evaluation of the effectiveness of airport facilities. In general, forecasts are needed for the short, medium, and long-term or approximately 5 years, 10 years, and 20 years. The simplest forecasting techniques are projecting into the future trends in travel volumes in the past (Horonjeff & McKelvey, 1998).

Regression Analysis Methods

a. Linear Regression Model Equations : $Y = a + bx$
b. Growth Regression Model Equation : $Y = e^{a+bx}$
c. Exponential Regression Model Equation : $Y = a(e^{bx})$

METHODOLOGY

Location of Research Study

Sultan Hasanuddin International Airport is an airport located 22 km from the city of Makassar, South Sulawesi province. The airport curbside at Sultan Hasanuddin International Airport is divided into 2 lanes of each lane serves as follows: Lane 1: Used as a place to drop and pick-up passengers to/from the terminal, Lane 2: Used to soar vehicles and vehicles going to the parking area.

The research study was conducted at the terminal departure and arrival curbside of Sultan Hasanuddin International Airport on February 23 - March 2, 2009 from Monday to Sunday during working hours at 08:00 to 10:00. The site location of Sultan Hasanuddin International Airport and departure and arrival curbside is shown in Figure 1 and 2 below.

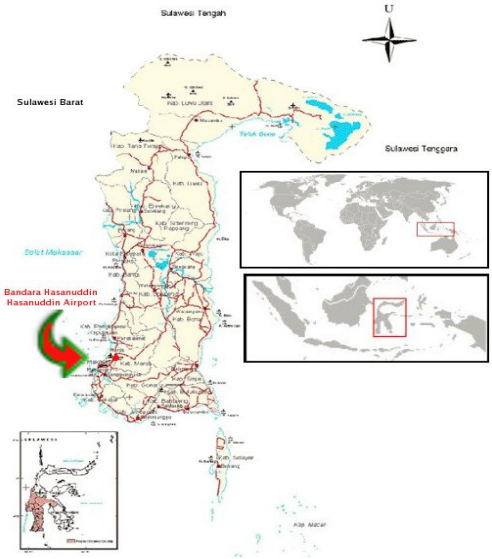
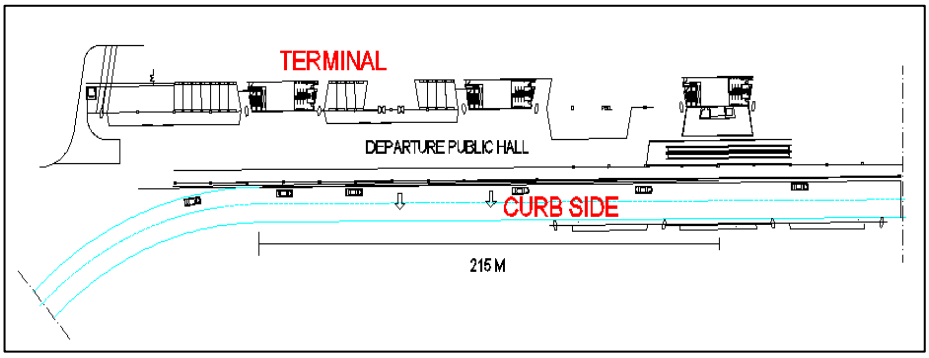


Figure 1. Location of Sultan Hasanuddin International Airport, Makassar



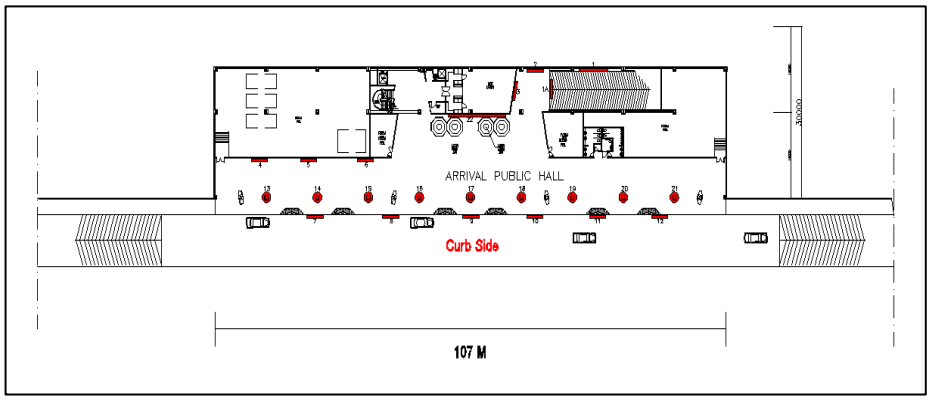


Figure 2a and 2b. Departure and Arrival Curbside

Data Collection

The data collection consists of primary data and secondary data. The primary data are the measurement of curbside length, types of vehicles entering and stopping on the object study, along with the number of passengers in the vehicles and time needed per vehicle for loading and unloading. While the secondary data were number of passengers and aircrafts either departing or arriving from the years 1998-2008 based on air traffic statistics from PT.Angkasa Pura 1, and passenger and aircraft traffic movements at peak hours in the passenger terminal of PT.Angkasa Pura 1.

RESULTS AND DISCUSSIONS

The Existing Conditions

The current conditions of curbside, passenger and aircraft movements, and the passenger peak hour at Sultan Hasanuddin International Airport, Makassar are shown in Table 3 to Table 8 below.

Table 3. Curbside Dimensions

Curbside	Length (m)	Width (m)	Size (m^2)
Departures	215	9	1,935
Arrivals	107	9	963

Source: PT. Angkasa Pura 1, Makassar

Tabel 4. Domestic Passenger Movement

Year	Arrive	Depart	Arrive + Depart	Transit	Total
1998	366,952	298,381	665,333	355,036	1.020.369
1999	316,014	269,265	585,279	289,058	874.337
2000	389,044	327,029	716,073	311,095	1.027.168
2001	489,015	419,379	908,394	355,082	1.263.476
2002	666,225	610,693	1,276,918	653,836	1.930.754
2003	990,560	926,631	1,917,191	653,836	2.571.027
2004	1,378,212	1,280,936	2,659,148	904,280	3.563.428
2005	1,342,336	1,246,230	2,588,566	947,925	3.536.491
2006	1,509,649	1,421,245	2,930,894	1,076,823	4.007.717
2007	1,646,778	1,514,679	3,161,457	1,273,150	4.434.607
2008	1,751,558	1,579,655	3,331,213	1,320,518	4.651.731

Source: PT. Angkasa Pura 1, Makassar

Based on table 4 above, the highest number of passengers arrival were 1,751,558 passengers and the highest number of passengers departure were 1,579,655 passengers in 2008.

Tabel 5. International Passenger Movement

Year	Arrive	Depart	Arrive + Depart	Transit	Total
1998	32,671	29,586	62.257	0	62,257
1999	27,123	26,430	53.553	0	53,553
2000	40,933	43,719	84.652	0	84,652
2001	37,901	36,835	74.736	0	74,736
2002	33,860	34,792	68.652	86	68,738
2003	29,023	33,576	62.599	86	62,685
2004	31,114	41,856	72.970	0	72,970
2005	28,329	32,418	60.747	0	60,747
2006	20,413	16,380	36.793	0	36,793
2007	16,562	14,606	31.168	0	31,168
2008	31,884	22,574	54.458	0	54,458

Source: PT. Angkasa Pura 1, Makassar

Based on table 5 above, the highest number of passengers arrival were 40,933 passengers and the highest number of passengers departure were 43,719 passengers in 2000.

Tabel 6. Domestic Aircraft Movement

Year	Arrive	Depart	Arrive + Depart	Transit	Total
1998	10,333	10,328	20,661	1.022	21,683
1999	8,213	8,173	16,386	894	17,280
2000	9,534	9,498	19,032	582	19,614
2001	12,012	11,990	24,002	378	24,380
2002	14,390	14,387	28,777	427	29,204
2003	19,284	19,139	38,423	272	38,695
2004	23,371	23,191	46,562	76	46,638
2005	21,223	21,087	42,310	106	42,416
2006	22,416	22,394	44,810	66	44,876
2007	24,217	24,209	48,426	113	48,539
2008	24,401	24,398	48,799	270	49,069

Sumber : PT. Source: PT. Angkasa Pura 1 Makassar Angkasa Pura 1 Makassar

Based on table 6 above, the highest number of arrival aircraft movement were 24,401 aircrafts, while the highest number of departure aircraft movement were 24,398 aircrafts in 2008.

Table 7. International Aircraft Movement

Year	Arrive	Depart	Arrive + Depart	Transit	Total
1998	347	348	695	0	695
1999	271	272	543	0	543
2000	420	412	832	0	832
2001	357	358	715	0	715
2002	346	347	693	0	693
2003	250	339	589	0	589
2004	247	393	640	0	640
2005	199	325	524	0	524
2006	155	171	326	4	330
2007	183	184	367	0	367
2008	259	256	515	0	515

Sumber : PT. Source: PT. Angkasa Pura 1 Makassar Angkasa Pura 1 Makassar

Based on table 7 above, the highest number of aircraft arrival were 420 aircrafts, while the highest number of aircraft departure were 412 aircrafts in 2000.

Tabel 8 . Peak Hour Passengers

Passenger	Depart	Arrive
Domestic	2,397	1,060
International	325	325
Total	2,722	1,385

Source: PT. Angkasa Pura 1, Makassar

The data collected from passenger terminal building at peak hour period was taken in August 2008 - February 2009 or from early Sultan Hasanuddin International Airport, Makassar is operated which can be seen in Table 7 above.

Tabel 9. Analysis of Departure Curbside

No	Curbside Length Indicator	Variable
1	The length of the existing curbside (m)	215
2	Peak hour passanger (PHP)	2,722
3	Departing passanger (DEP)	274
4	Vehicle length (VL) (m)	7
5	Dwell time (DT) (min)	2
6	Person/vihicle (P/V)	4
7	Service time (ST) (60 min)	60
8	The length of the required curbside	142.78
9	*Level of Service* (LOS) at the curbside	1.51

Source: Results Analysis

The length of the departure curbside at existing condition is still adequate with a value of 1.51 (LOS A).

Tabel 10. Analysis of Arrival Curbside

No	Curbside Length Indicator	Variable
1	The length of the existing curbside (m)	107
2	Peak Hour Passanger (PHP)	1,385
3	Arriving Passanger (ARR)	305
4	Vehicle Length (VL) (m)	7
5	Dwell Time (DT) (min)	2
6	Person/Vihicle (P/V)	4
7	Service Time (ST) (60 min)	60
8	The length of the required curbside	62.98
9	Level of Service (LOS) at the curbside	1.70

Source: Results Analysis

The length of the arrival curbside at existing condition is still adequate with a value of 1.70 (LOS A).

Forecasting Results for Passenger and Aircraft

Forecasting modeling used for passenger and aircraft movements was SPSS 11.0. The forecasting results can be seen in the Tables 11, 12, 13 and 14.

Tabel 11. Forecasting of Passenger Departure (Domestic and International)

Year	Forecasting of Passenger Departure
2009	1,847,631
2010	2,000,621
2011	2,153,607
2012	2,306,593
2013	2,459,579

Source: Calculation Results

The results of this analysis based on linear regression model of SPSS 11.0, the formula Y = 853,224.6545 + 76493.0727 X, where the value of Y is the number of passengers departing and X (year) projections of passengers depart.

Tabel 12. Forecasting of Passenger Arrival (Domestic and International)

Year	Forecasting of Passenger Departure
2009	1,992,209
2010	2,154,908
2011	2,317,607
2012	2,480,306
2013	2,643,005

Source: Calculation Results

The results of this analysis based on linear regression model of SPSS 11.0, the formula Y = 934,664.6318 + 81349.5500 X, where the value of Y is the number of passengers coming and X (year) projections of the passengers arrived.

Tabel 13. Forecasting of Aircraft Departure (Domestic and International)

Year	Forecasting of Aircraft Departure
2009	28,307
2010	30,112
2011	31,918
2012	33,724
2013	35,529

Source: Calculation Results

The results of this analysis based on linear regression model of SPSS 11.0 formula Y = 16569.7954 + 902.8409 X, where the value of Y is the number of planes departing and X (year) projection of the plane departed.

Tabel 14. Forecasting of Aircraft Arrival (Domestic and International)

Year	Forecasting of Aircraft Departure
2009	28,315
2010	30,119
2011	31,923
2012	33,726
2013	35,530

Source: Calculation Results

results of this analysis based on linear regression model of SPSS 11.0, the formula Y = 16591.6227 + 901.8318 X, where the value of Y is the number of planes arriving and X (year) projection of the plane arrived.

Tabel 15. Forecasting of Peak Hour Passenger Departure

No	Service Level Indicators	Variable
1	Aircraft capacity	150
2	Aircraft movement	6.08
3	Number of passengers	421.16
4	Number of passengers at peak hours (4=1+2x3)	2,712.26

Source: Calculation Results

Tabel 16. Forecasting of Peak Hour Passenger Arrival

No	Service Level Indicators	Variable
1	Aircraft capacity	150
2	Aircraft movement	6.08
3	Number of passengers	452.27
4	Number of passengers at peak hours (4=1+2x3)	2,903.40

Source: Calculation Results

The projections for the number of passengers departed during peak hours (PHP) in 2013 amounted to 2712 (see Table 13), while the number of passenger arrived at peak hours (PHP) in 2013 amounted to 2,903 (see Table 14), which will be used to analyze the length of curbside departure and arrival.

Forecasting Results for Curbside Departure and Arrival Passenger and Aircraft

Forecasting Results for Curbside Departure and Arrival Passenger and Aircraft are shown in the Tables 17 and 18 below.

Tabel 17. Analysis of Curbside Departures in 2013

No	Curbside Length Indicator	Variable
1	The length of the existing curbside (m)	215
2	Peak Hour Passanger (PHP)	2,712.26
3	Departing Passanger (DEP)	421.16
4	Vehicle Length (VL) (m)	7
5	Dwell Time (DT) (min)	2
6	Person/Vihicle (P/V)	4
7	Service Time (ST) (60 min)	60
8	The length of the required curbside	133.65
9	Level of Service (LOS) at the curbside [(9) = (1) / (8)]	1.61

Source: Calculation Results

The length of *curbside* departure in 2013 is still adequate, the value of service level 1.61 (LOS A).

Tabel 18 . Analysis of Curbside Arrival in 2013

No	Curbside Length Indicator	Variable
1	The length of the existing curbside (m)	1075
2	Peak Hour Passanger (PHP)	2,903.40
3	Arriving Passanger (ARR)	453
4	Vehicle Length (VL) (m)	7
5	Dwell Time (DT) (min)	2
6	Person/Vihicle (P/V)	4
7	Service Time (ST) (60 min)	60
8	The length of the required curbside	142.96
9	Level of Service (LOS) at the curbside [(9) = (1) / (8)]	0.75

Source: Calculation Results

The length of *curbside* arrival in 2013 was not adequate, the value of service level is 0.75 (LOS C), where require of curbside length added to 36 m.

Tabel 19. Recapitulation of Airport Curbside Development at Sultan Hasanuddin International Airport, Makassar

No	Facility	Existing Conditions (m)	Airport Curbside Development (m)		Curbside Length Added (m)		Information
			2009	2013	2008	2013	
1	Curbside Departure	215	142,78	133,65	* *	* *	Domestic & International
2	Curbside Arrival	107	62,98	142,96	* *	36	Domestic & International

Note: * * fulfilled
Source: Calculation Results

FINDINGS AND RECOMMENDATIONS

The findings and recommendations of the study can be summarized as follows: i) curbside length at the existing condition for departure and arrival curbside are still adequate and level of service (LOS) at existing curbside both departures and arrivals are at the level of service A, while to anticipate the flow of passengers until 2013 empirically still adequate for curbside departure and not adequate for curbside arrival where the length of the required curbside is 143 m, ii) to anticipate the delay of vehicles circulations at the curbside area, vehicles (private car, car rental, valet parking, taxi) can not stop more than five minutes or parking along the curbside area, iii) the need to construct the pedestrian way from terminal to parking area or vice-versa - provided with eco-friendly landscape, iv) vehicles parked at the departure and arrival curbsides must be moved to the parking area to accelerate the vehicles circulation flows, v) implement strict regulations, and vi) designers of airports should plan through expansion of existing curbside facilities in the long-term planning.

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