

Feasibility Study of Sub Terminal Stasiun Hall Bandung City Period 2009-2019

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Due to rapid population growth in the city of Bandung, the Bandung City Government must ensure existing transportation facilities and infrastructure are adequate to accommodate such growth. Problems have been seen, however, in Bandung today in regards to transportation facilities or places to accommodate mass transit vehicles, known as terminal. According to the Department of Transportation, one of the problems is in the Sub Terminal Stasiun Hall, which already feels uncomfortable. However, this terminal is an inner city terminal that needs to be maintained. Therefore, to find out the feasibility of Sub Terminal Stasiun Hall, as a type C terminal for the period 2009-2019, it is necessary to evaluate the Sub Terminal Stasiun Hall so that its services can be improved with reference to the regulations issued by the Bandung City Transportation Agency and studies of existing literature.

Key words: *Sub Terminal, feasibility study, evaluation.*

Introduction

The population in the city of Bandung is increasing every year. Due to rapid population growth in the city of Bandung, the Bandung City Government must ensure existing transportation facilities and infrastructure are adequate to accommodate such growth. Problems have been seen, however, in Bandung today in regards to transportation facilities or places to accommodate mass transit vehicles, known as terminal.

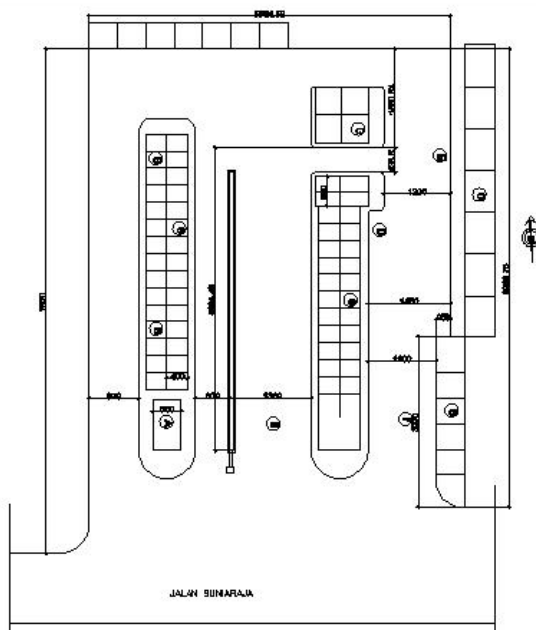
According to the Department of Transportation, one of the problems is in the Sub Terminal Stasiun Hall, which already feels uncomfortable. This Sub Terminal is a type C terminal, but in reality the facilities at the terminal are inadequate.

This terminal is, however, an inner city terminal that needs to be maintained. Therefore, to find out the feasibility of maintaining Sub Terminal Stasiun Hall, as type C terminal for the period 2009-2019, it is necessary to evaluate the Sub Terminal Stasiun Hall so that its services can be improved with reference to the regulations issued by the Bandung City Transportation Agency and studies of existing literature.

Literature Review

Sub Terminal Stasiun Hall is located on Kebon Jati Street in the city of Bandung. The Sub Terminal Stasiun Hall has a land area of 4326 m² which is specifically for public transportation as a pick/drop point for passengers. This Sub Terminal is a type C terminal which aims to serve public vehicles for rural transportation. This terminal is very close to the location of shops. The use of land around the terminal is in the form of settlements and trade, so the possibility of terminal expansion is not possible. The location of the Sub Terminal Stasiun Hall has largely changed its function to become a place of trade, with street vendors setting up stalls, so that public transport cannot enter the terminal. Existing conditions indicate that tackling often takes place on Jalan Kebon Jati which can cause congestion on this road. Although it does not cause congestion, this condition means that the terminal is not optimal.

Figure 1. Plan of Sub Terminal Stasiun Hall



Methodology

The process of completing this research can be explained as follows:

1. Identify problem
2. Data Collection: Primary and Secondary Data
3. Check for capacity and completeness Sub Terminal Stasiun Hall in accordance with the rules of the Department PU Bina Marga
4. Analysis of handling scenarios
5. Selected handling scenario
6. Technical design
7. Conclusions and suggestion

Analysis and Discussion

Existing Conditions

The existing conditions reviewed in the field are divided into three parts, namely:

1. The main facilities are the public transportation entrance and exit gate, as well as public transport parking areas.
2. Supporting facilities reviewed are public parking areas, information rooms, stall, toilets, prayer rooms, public telephones, canteens.
3. The terminal administration reviewed is the terminal management office, retribution post and parking.

Based on the results of the field survey, not all facilities at Sub Terminal Stasiun Hall are in accordance with the 1995 Directorate General of Land Transportation regulations which can be seen in table 1 below.

Table 1: Facilities at Sub Terminal Stasiun Hall

No	Main Facilities	Availability		Condition			Amount		Dimension
		Yes	No	Good	Medium	Poor	Lane	Unit	
1.	Departure Lane	√	-	-	√	-	3	-	4 m
2.	Arrival Lane	√	-	-	√	-	3	-	4 m
3.	Terminal Office Building	√	-	√	-	-	-	1	20 m ²
4.	Passenger Waiting Place	-	√	-	-	-	-	-	-

5.	Signs	-	√	-	-	-	-	-	-
6.	Information Board	√	-	-	-	√	-	3	-
7.	Parking Lot	√	-	-	√	-	-	-	~
	Supporting Facilities								
1.	Toilet	√	-	-	√	-	-	10	12 m ²
2.	Prayer Room	√	-	-	√	-	-	3	9,6 m ²
3.	Kiosk / Canteen	√	-	-	√	-	-	27	1004 m ²
4.	Information Room	-	√	-	-	-	-	-	10 m ²
5.	Treatment Room	-	√	-	-	-	-	-	-
6.	Payphone	√	-	-	√	-	-	3	6 m ²

Based on the survey of vehicle and passenger flows at the terminal, the peak time of each survey are different, namely:

- In the public transportation survey, the peak time occurs on Monday 6 July 2009 at 8:15 a.m. to 08:30 and 17:15 to 17:30 with a total of 48 public transportations.
- In a private vehicle flow survey, the peak time occurred on Monday 6 July 2009 at 17.15-17.30 with a total of 3 private vehicles.
- In the motorcycle flow survey, the peak time occurred on Monday 6 July 2009 at 13.30-13.45 and 17.00-17.15 with a total of 11 motorbikes.
- In the passenger flow survey the peak time occurred on Monday 6 July 2009 at 8:15 a.m. to 08:30 with a total of 126 passengers.

Capacity Analysis

Not all public transportation routes enter the terminal. There are only a few special shelters for certain public transportation, such as Sarijadi-St.Hall, Gunung Batu-St.Hall, and Bandung-Subang. Public transportation, private cars, motorbikes, and even non-motorized vehicles are free to park inside the terminal. This indicates that the conditions inside the terminal are really poorly maintained and less organized.

A. Terminal Area

➤ Rush hour review

Maximum number of public transportation = 48 vehicle/15' = 192 vehicle/hour

Spacious for a vehicle = (5 x 2,3)m = 11,5 m²

Area of free space = (4,7 x 2,5) m = 11,75 m²

Area needed (L_{fas}) = $J_p \times \frac{t}{60} \times L_k$

$$= 192 \times \frac{15}{60} \times (11,5 + 11,75) \text{ m}^2$$

$$= 1116 \text{ m}^2$$

B. Public Vehicle Parking

➤ Rush hour review

Maximum number of public vehicle = 3 vehicle / 15' = 12 vehicle/hour

Private car facility = (5,0 x 2,5)m = 12,5 m²

Assumption :

Calculation of 4-wheeled vehicle facilities is multiplied, for the end of the vehicle's moving space.

Facility needs :

$$(L_{\text{fas}}) = 12 \times \frac{15}{60} \times (12,5) \times 2 \text{ m}^2$$

$$= 75 \text{ m}^2$$

C. Motorcycle

➤ Rush hour review

Maximum number of motorcycle = 11 vehicle/ 15' = 44 veh./hour

Assumption :

Motorcycle facility = (2,5 x 1,0)m²

Facility needs :

$$(L_{\text{fas}}) = 44 \times \frac{15}{60} \times 2,5 \text{ m}^2 = 27,5 \text{ m}^2$$

Facility needs (L_{fas}) for public vehicle and motorcycle :

$$(L_{\text{fas}}) = 75 + 27,5 = 102,5 \text{ m}^2$$

D. Bathroom Size

$$J_{\text{ps}} = J_{\text{pnp}} \times \frac{t}{60} = 126 \times \frac{15}{60} = 31,5 \text{ person} \approx 32 \text{ person}$$

$$L_{\text{fas}} = 32 \times \frac{15}{60} \times 1,1 = 8,8 \text{ m}^2$$

E. Kiosk Size

$$J_{\text{ps}} = 32 \text{ person}$$

$$L_{\text{fas}} = 32 \times \frac{15}{60} \times 1 = 8 \text{ m}^2$$

F. Worship Space Size

$$J_{\text{ps}} = 32 \text{ person}$$

$$L_{\text{fas}} = 32 \times \frac{15}{60} \times 2 = 16 \text{ m}^2$$

G. Passenger room, delivery and pick-up

➤ Rush hour review

Public transportation depart = 56 vehicle/ 15' = 224 vehicle/hour

The number of passengers departing on average (JP)

JP = 224 vehicle/hour x 3 person/ vehicle = 672 vehicle/hour

Maximum number of people = 126 person/ 15' = 504 person/hour

Maximum number of private cars = 12 vehicle/hour

$$\begin{aligned}
 \text{Minimum number of passenger} &= 2 \text{ person/vehicle} \\
 \text{Total number of passengers} &= 12 \text{ vehicle/hour} \times 2 \text{ person/vehicle} \\
 &= 24 \text{ person/hour} \\
 \text{Total number of motorcycle} &= 11 \text{ vehicle/hour} \\
 \text{Maximum number of passenger} &= 2 \text{ person/vehicle} \\
 \text{Total number of passenger} &= 11 \text{ vehicle/hour} \times 2 = 22 \text{ person/hour} \\
 \text{Total people} &= 672 + 504 + 24 + 22 \\
 &= 1222 \text{ orang / jam}
 \end{aligned}$$

Number of Passengers Departing

$$\begin{aligned}
 \text{Public transportation depart} &= 56 \text{ vehicle/ } 15' = 224 \text{ vehicle/hour} \\
 \text{The number of passengers departing on average (JP)} &= 224 \text{ vehicle/hour} \times 3 \\
 \text{person/ vehicle} &= 672 \text{ vehicle/hour}
 \end{aligned}$$

Amount of Delivery and Pickup (JPP)

$$\begin{aligned}
 \text{(JPP)} &= 1222 - 672 = 550 \text{ person/hour} \\
 \text{Facility needs} &= L_{fas} = \text{JPP} \times t/60 \times L_k \\
 &= 550 \times \frac{15}{60} \times 1 \text{ m}^2 = 137,5 \text{ m}^2
 \end{aligned}$$

To find out the terminal capacity in 2019, the population growth rate is used as a prediction of the number of passengers in 2019.

Table 2: Prediction of Public Vehicle Users

No.	Year	Amount	Prediction of Public Vehicle Users (10%)
1	1999	2543476	254347,6
2	2000	2136260	213626,0
3	2001	2161252	216125,2
4	2002	2211554	221155,4
5	2003	2228268	222826,8
6	2004	2232624	223262,4
7	2005	2270970	227097,0
8	2006	2296848	229684,8
9	2007	2329928	232992,8

From table 2 it can be concluded that every year the number of residents in the city of Bandung continues to grow. Likewise with public transport users. The Population Growth Rate (LPP) was 1.88%. This population growth rate is used as an assumption to predict the growth rate of the number of passengers at Sub Terminal Stasiun Hall every year. The prediction of the number of passengers in 2019 is calculated using the following formula.

$$P = A (1+i)^n$$

Where :

P = number of passenger years plan

A = current number of passengers

n = number of years plan

i = percentage growth rate

$$P = 126 (1+1,88\%)^{10}$$
$$= 151,7959 \approx 152 \text{ person}$$

Based on the calculation statistics above, the number of passengers who came to the Sub Terminal Stasiun Hall in 2019 were 152 persons. This amount is a reference for designing facility requirements at the Sub Terminal Station Hall to be planned. Recapitulation of the results of the analysis of facility requirements can be seen in table 3.

Table 3: Recapitulation of Results of Facility Needs Analysis

No	Terminal facilities evaluated	Capacity (m ²)	Needs for 2019 (m ²)	Match	Not Match
1.	Public transportation Parking	~	1116		√
2.	Private Vehicle Parking	~	102,5		√
3.	Waiting Room	-	480		√
4.	Information Room	-	10		√
5.	Toilet	12	11	√	
6.	Prayer Room	9,6	19		√
7.	Kiosk	1004	10	√	

From table 3 it can be concluded that the capacity of some facilities does not match the needs. Given this, a solution must be determined to overcome this problem. The solution can be achieved by redesigning the terminal, where the evaluated Sub Terminal Stasiun Hall facilities are then redesigned according to the required capacity.

Solution

From the terminal facilities that have been analyzed, it can be determined the land area needed for the terminal redesign of Sub Terminal Stasiun Hall is 4033 m². Determination of the terminal area refers to the analysis of the needs and existing conditions of the terminal area. The redesign of this terminal is in accordance with the existing type C level terminal.

Table 4: Area of each facility

No.	Description	Area (m ²)		
		<i>Existing</i>	Needs Analysis	<i>Redesign</i>
1.	Vehicle			
	City Transport Parking Space	~	1116	1120
	Village Transport Parking Space	~		
	Private Vehicle Parking Space	~	102,5	105
	Vehicle Circulation	~	1.100	1.100
	Rest Room	-	30	30

	Backup parking space	~	550	550
2.	Service Users			
	Rest Room	-	480	480
	Person Circulation	137,5	192	200
	Toilet	12	40	40
	Kiosk	1004	288	300
	Prayer Room	9,6	40	40
3.	Operational			
	Administrative Room	-	39	39
	Retribution	~	6	6
	Information Room	-	8	8
	First Aid Room	-	15	15
Total Area			4.006,5	4.033
Development Reserve			-	-
Terminal Area		4.016,16	4.006,5	4.033
Terminal Area (ha)		0,40	0,40	0,40

On redesign of Sub Terminal Stasiun Hall, it was carried out:

1. Procurement of space for passenger waiting rooms.
2. Procurement of administrative, information and treatment rooms.
3. Settling for a place of retribution.
4. Increasing services for prayer room facilities and toilets.
5. Transfer of facilities or changes in dimensions of facilities that are not functioning optimally.

Alternative solutions with non-technical methods, namely with terminal settings. The arrangement meant here is terminal management that regulates the activities of public transport which include:

- A. Departure time
- B. Pattern of public transportation and private vehicle movement in the terminal
- C. Facilities signs and parkings in the terminal

Table 5: Signs and Marking Facilities

No.	Facility	<i>Existing</i>	<i>Redesign</i>
1.	a. Transverse Parking Markings	No	Yes

	b. Sloping Line Parking Markings	No	Yes
2.	Signpost	No	Yes
3.	Prohibition signs	Yes	Yes
4.	Command Sign	No	Yes
5.	Lighting	Yes	Yes

Conclusion and Suggestion

Based on data analysis and discussion of the problems reviewed in this research, some conclusions can be made as follows:

1. Location of facilities in the terminal are easily accessible by terminal users.
2. The condition of the facilities in the terminal is quite good for terminal users but is less convenient to use.
3. Sub Terminal Stasiun Hall is a type C terminal. But in reality it is not in accordance with the requirements set. For example, the extent of facilities that are not fulfilling, the main facilities are not all available, and the function of the terminal has turned into a place of trading.
4. The area of the terminal resulting from the analysis of needs is 4,006.5 m² while the existing terminal area of Hall Station is 4016.16 m².

Some suggestions that can be proposed for reference in future studies and as a reference for managers of Sub Terminal Stasiun Hall are:

1. To increase the service level of this terminal, what needs to be considered is:
 - Management and traffic engineering in the terminal area
 - Provision of main facilities and supporting facilities that do not yet exist
 - Facility cleanliness needs to be improved
2. The placement of facilities is centered on one building so that the movement of passengers is more directed so as not to hinder the movement of vehicles in the terminal.
3. Provision of land for development reserves.
4. Placement of signs and markings facilities to improve security, comfort and satisfaction for terminal users.

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REFERENCE

- [1] Keputusan Menteri Perhubungan Nomor : 31 Tahun 1995, Tentang Terminal Transportasi Jalan.
- [2] Morlok, Edward K. 1984. Pengantar Teknik dan Perencanaan Transportasi. Terjemahan Ir. Johan Kelanaputra Hainim. Jakarta : Erlangga.
- [3] Studyana, Moch. Duddy, Ir., MT. 2005. Terminal Bis. Bandung : Politeknik Negeri Bandung.
- [4] Sinaga, O., Saudi, M. H. M., Roespinoedji, D., & Razimi, M. S. A. (2019). The Dynamic Relationship between Natural Gas and Economic Growth: Evidence from Indonesia. *International Journal of Energy Economics and Policy*, 9(3), 388-394.
- [5] Saudi, M. H. M., Sinaga, O., Roespinoedji, D., & Razimi, M. S. A. (2019). The role of renewable, non-renewable electricity consumption and carbon emission in development in Indonesia: Evidence from Distributed Lag Tests. *International Journal of Energy Economics and Policy*, 9(3), 46-52.