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Analysis of Traffic Engineering Management Needs for the Construction of a Mental Hospital Prof. Dr. V. L. Ratumbuysang Manado, North Sulawesi Province

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ABSTRACT

Traffic engineering management is part of the traffic impact caused by land-use development. New land-use development will cause a rise and pull of movement (trip generation) during the construction and operation of new land use. Any new land-use development that becomes the center of activity will cause a resurgence in traffic.

The construction of the Prof. Dr. V. L. Ratumbuysang Manado Mental Hospital, North Sulawesi Province, caused a revival of the movement both now and in the future. The traffic generation caused by infrastructure development is classified as moderate traffic generation with a total of 525 junior high school/day.

The performance of the Kalasey - Sea Road section has an existing condition of service level A and a speed of 30 km/hour. During the construction period of service level A speed 30 km / h. During the operation period, the performance of the road section service level A speed is 30 km / h.

Traffic engineering management on Kalasey - Sea Collector Road due to the construction of Prof. Dr. V. L. Ratumbuysang Mental Hospital: Kalasey Dua - Sea Road: 1 careful sign, 1 Apill sign, 1 entry sign, 1 prohibition sign. Internal Area: 1 piece of uphill sign, 1 descending sign, 1 right turn sign, 1 gathering point sign.

Keywords: Trip generation, road service level, traffic engineering management

1. INTRODUCTION

1.1. Background

Traffic management and engineering is a series of businesses and activities that include planning, procurement, installation, arrangement and maintenance of road equipment facilities in order to realize, support and maintain security, safety, order, and smooth traffic (PM 96 of 2015). Traffic engineering management is part of the analysis of traffic impacts caused by land-use development. New land-use development will cause a rise and pull of movement (Trip generation) during the construction and operation of new land use (PM 17/2021 and Pandey, 2022).

The construction of a center of activity that attracts or generates traffic at a particular location on the side of the road will affect the surrounding traffic, traffic impact analysis studies or studies are used to predict whether the transportation infrastructure in the area of influence of the development can serve existing traffic, plus the traffic generated or attracted by the development. The construction and operation of the activity center requires traffic management and engineering analysis that will have an impact on the smooth flow of traffic within the activity center and on the road network around the activity center.

Any construction and development of the activity center will have an impact on the surrounding traffic, including

on traffic and road transportation. The construction and development of activity centers do not pay attention to the impact on road traffic, resulting in a decrease in the level of road services both during construction and operational periods.

The construction and operation of Prof. DR. V. L. Ratumbuysang Manado Mental Hospital located on Jalan Kalasey Dua, Kalasey Dua Village, Mandolang District, North Sulawesi Province is expected to attract traffic movements that affect road performance around the location. Therefore, to calculate the magnitude of the impact of the development plan on existing roads, it is necessary to analyze the needs of traffic engineering management and road transportation. The expected traffic impact is carried out in the form of traffic management and engineering and road transport.

1.2. Problems

The problems of this research are:

1. What is the value of the rise and pull of movement *(trip generation*) of the operation of Prof. Dr. V. L. Ratumbuysang Manado Mental Hospital?

2. How is the traffic engineering management on the Kalasey-Sea road due to the construction of Prof. Dr. V. L. Ratumbuysang Manado Mental Hospital?

1.3. Research Objectives

The objectives of the study are as follows:

1. Analyzing the value of awakening and attraction *(trip generation) of* the operation of Prof. Dr. V. L. Ratumbuysang Manado Mental Hospital?

2. Analyzing traffic engineering management on the Kalasey - Sea collector road due to the construction of Prof. Dr. V. L. Ratumbuysang Mental Hospital.

1.4. Research Benefits

The benefits of research are as follows:

1. Provide information to the government and builders in order to anticipate the possible negative impacts of development on traffic performance.
2. Propose forms of traffic management and engineering to improve traffic performance.

1. THEORETICAL FOUNDATION

2.1. Travel Revival

Movement generation or travel generation is part of transportation modeling that estimates the amount of movement coming from a zone or land use, or the amount of movement attracted to a land use or zone. Traffic movement is a land-use function that produces traffic movement. Traffic generation includes traffic leaving a location and traffic heading to or arriving at a location (Tamin, 2000 and Pandey, 2022)

Movement generation consists of 2 namely: 1) Trip production: the number of trips produced by a zone, 2) Trip attraction: the number of trips drawn by a zone. Figure 2.1. shows trip production and trip attraction.

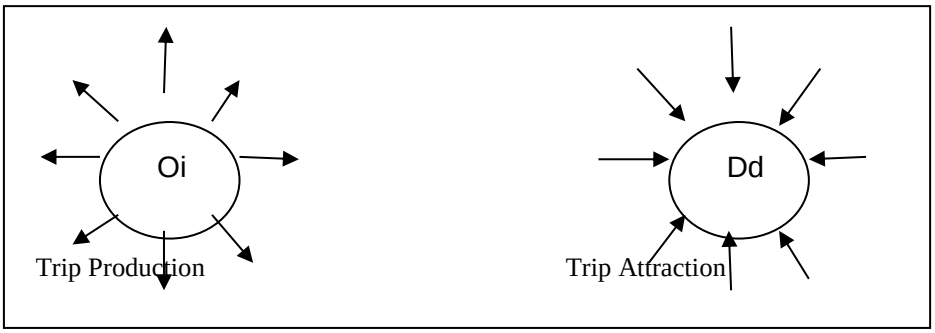

Figure 1. Movement Generator

2.2. Traffic flow characteristics

a. Traffic Volume

According to MKJI 1997, traffic flow is the number of motorized vehicles passing through a point on a piece of road per unit of time expressed in units of kend/hour (Qkend) or Average Daily Traffic (LHR).

b. Traffic Speed

MKJI 1997 explains speed, namely the average speed of all vehicles passing through a point or lane at a certain period of time in units of km/hour.

Speed which is the ratio between distance and travel time is calculated by the following formula:

$$V = \frac{s}{t} \quad \text{..... (Press 1.)}$$

Wher: V = Speed

s = Distance

t = Travel time

c. Traffic Density

Density is the ratio between volume and speed expressed in units of smp/km.where density shows the performance of road sections, if the higher density value of a section shows poor performance as well.

d. VC Ratio

VC Ratio is one aspect in measuring the performance parameters of road sections, where the existing traffic flow is compared to road capacity.

Table 1. Service Level Characteristics

Level Service	Traffic flow characteristics	Degree of Saturation
A	Free flow conditions with high speed and low traffic volume. The driver can choose the desired speed without hindrance	0,00 – 0,19
B	In the zone of stable current. The driver has enough freedom to choose his speed.	0,20 – 0,44
C	In the zone of stable current. The driver is limited in choosing his speed.	0,45 – 0,74
D	Approaching unstable currents where almost the entire driver will be restricted. Service volume relates to acceptable capacity	0,75 –0,85
And	Traffic volume is close to or at capacity. The current is unstable with frequent stopping conditions.	0,85 – 1,00
F	Currents that are forced or stuck at low speeds. Long queues and big obstacles.	Greater than 1.00

Source: Abubakar. I, 1995

2.3. State Of The Art

State-of-the-art is a detailed and unique research design compared to previous research. State-of-the-art can be used as a basis for research that explains the difference between previous research and the research carried out.

Morlock. K.E (1995); states that land use greatly affects the transportation system in the surrounding environment. The land use of the hospital construction will generate a number of movements of people and vehicles that need to be analyzed in numbers. The need for traffic management has a good impact on the construction of hospitals and other land uses.

Permenhub 17/2021; The implementation of traffic impact analysis is analyzed based on the amount of generation and pull of traffic movement. The amount of traffic generation is categorized into 3 categories, namely; low traffic generation, medium traffic generation and low traffic generation. Traffic generation for hospitals is analyzed based on the number of beds. Low traffic generation of 75 to 200 beds; moderate traffic generation of 201 to 700 beds; High traffic generation is greater than 700 beds.

Nurdin R. D. et al (2022) stated that the development of the Hospital will cause several influences on road sections such as; a decrease in road capacity, increase in side obstacles, increase in parking needs. Linear regression analysis method for the analysis of movement generation and pull. Results of parking needs analysis 265 SRP cars 265 SRP cars per hour; 200 SRP motorcycles while available 238 SRP cars and 140 SRP motorcycles.

Sumajouw.J. et al, 2013 stated that any change in land use, both changes in category and intensity, will generate traffic. Traffic generation has an effect on traffic. To anticipate the occurrence of considerable traffic influence on the transportation network around the development, it is necessary to conduct a *traffic impact analysis study*. The construction of new buildings in several parts of the Unsrat campus area such as the construction of Campus Hospitals, the construction of new lecture buildings in several faculties, and the construction of other new buildings are expected to affect the volume and system of traffic movement in several road networks on campus and road networks around the Sam Ratulangi University campus including the Wolter Monginsidi Road section and the Bahu sub-district area road. Study Traffic impact analysis in the form of traffic engineering management.

Pandey S.V. 2013, Roads built by the government should provide safety to road users. The implementation of the Law on roads is very important to realize safe roads. The results of the analysis show that most roads in North Sulawesi Province have not provided safety guarantees for road users.

Fakhri K and Mudiyono R (2020) stated: SD IT Al-Mawaddah is currently a favorite educational alternative that has aspects of general science and also prioritizes Islamic religious knowledge in Tlogosari Semarang. This makes SD IT Al-Mawaddah need to expand development to facilitate and increase capacity. The purpose of this study is to analyze the influence of the exit and entry of vehicles for the Al-Mawaddah IT Elementary School building construction project, as well as analyze the circulation of vehicle arrangements that occur in the study area, and predict the increase in the number of students in the next 10 years. The method used is MKJI 1997 to analyze the condition of road sections and traffic loads that will occur. The results of the study showed that the morning rush hour and afternoon rush hour volume per capacity (VC ratio) in the study area had a service level of A. In the current conditions in 2020, vehicle parking locations are insufficient for the needs of employees and guests. Therefore, it is necessary to add a new parking lot.

Zuhdy, Basuki, Purwanto (2013): The construction of the Puncak Kertajaya Apartment will cause traffic problems. A large number of occupants will create a large traffic load, so a traffic impact analysis must be carried out. Prediction of traffic load and influence on traffic as a result of analysis, will produce recommendations to anticipate the impact on traffic.

Sebayang N, Nainggolan.T.H, Ma'aruf A (2019); The construction of the New Hospital in Probolinggo City requires improvement of the intersection in the form of geometric changes in the form of improvement of the short-sighted widening intersection because there have been traffic delays in the research cockey.

Suthanaya. P. A, Wedagama, Purwanto (2019); Taman Rama School is a school that has 1144 students. Based on the Regulation of the Minister of Transportation Number PM 75 of 2015 concerning the Implementation of Traffic Impact Analysis, Taman Rama School is included in the mandatory criteria for traffic impact analysis. The data were analyzed with formulas and methods from the 1997 Indonesian Road Capacity Manual, assisted using CONTRAM software.

The parking capacity provided by Taman Rama School is still more than the need where 179 SRP motorcycles and 107 SRP cars are available while the highest usage is 90 SRP cars and 154 SRP motorcycles.

Muchlisin 2016; The construction of the Jogya One Park mixed-use plan led to the pull of 1 bus and truck per hour, cars 73 vehicles/hour, motorcycles 41 vehicles/hour. The number of generators is 1 bus and truck per hour, cars 56 kend/hour and motorcycles 29 kend/hour.

Prayoga L. H. et al (2021); Bali Province is a province in Indonesia with rapid economic growth. The impact of this economic growth is the acceleration of the development of activity centers and the rise of travel in this province. The rise of the trip can affect the performance of existing road sections. Therefore, an analysis of the traffic impact due to additional travel generation needs to be carried out, to minimize the negative impact of additional travel generation on existing roads, especially on national roads. This study was conducted on several national road sections that received priority to be handled, so that proposals for handling them could be made, and it could be estimated that the improvement in the performance of these road sections due to the proposed handling. After handling several national road sections, this study shows that the largest performance improvement occurred on the Denpasar-Tuban Highway section. However, there are also road sections that do not experience significant performance improvement, which means that the proposed handling of these road sections needs to be supported by additional road capacity, to improve the performance of these road sections.

Joseph. M (2021) :P factory building PT. Biotek Farmasi Indonesia has an impact that must be engineered so as not to cause traffic disruptions. The purpose of this study is to determine the impact of traffic caused by the construction of the factory and provide recommendations for appropriate handling to minimize the impact. The method used to analyze the data obtained is by calculating the Indonesian Road Capacity Manual (MKJI 1997) and for the calculation of transportation planning using the *4 (four) step model method*. The results of the analysis showed that the construction of the PT. Biotek Farmasi Indonesia is estimated to cause new revival and pull during the construction period of 22 junior high school/day and the operational period for the pull of 94.0 junior high school/day and the rise of 71.6 junior high school/day, as a result of which it causes traffic impacts on roads in the surrounding area so that mitigation measures are given to minimize the impact of traffic during the construction period in the form of setting material vehicle hours, installing traffic signs during construction, transporting materials in accordance with the procedure. And the operational period is in the form of installing traffic signs during operational periods, structuring vehicle and pedestrian circulation, providing pedestrian facilities, providing parking spaces, asset security and emergency conditions.

Wahab W,Prices A. P, Roza A (2020); Padang Institute of Technology (ITP) is the oldest engineering campus in the province

West Sumatra is located in two locations, namely on Jalan Gajah Mada (Campus I) and on Jalan DPR (Campus II). ITP is currently conducting

Construction of Campus II on an area of ??± 1.5 HA. The construction of Campus II has the potential to increase traffic volume.

The increase in traffic volume will affect road performance so further study is needed. Purpose of the study

This is to analyze how much impact the traffic due to the construction of campus II has on the performance of road sections.

The analysis carried out includes analysis of road section performance, on pre, period, and post-construction conditions; includes projections

parking space needs. The results showed that the performance of the DPR road section in pre-construction conditions and the period

of construction is at level B (good performance), but in the post-construction period it is at level C (sufficient performance).

Meanwhile, the performance of the Bypass road section in pre-construction, construction, and post-construction conditions is at

level B (good performance) but already close to level C (sufficient performance).

Pandey, S.V, et al (2022) stated that any construction of an activity center will affect the road environment around the construction site. The generation and pull of movement at the center of activity is strongly influenced by the type of activity that pulls a number of vehicles. The Kaiya Maelang arterial road section is not affected by the construction of a corn drying factory in Bolaang Mongondow Regency because the type of awakening that occurs is low traffic generation.

Tamin, 2000. The generation and pull of movement is the main cause of the movement of traffic flow on the road. Any new land-use development or development will cause traffic disruptions. Traffic disruptions will have an impact on movement patterns.

2.4.Growth Rate

The population growth rate model is the basis for predicting future growth in vehicle movements:

$$P_{t+q} = P_t(1+r)^q \quad \text{(Pers 2.2)}$$

where

Pt+q = Number of inhabitants or movements in the year (t+q)

Pt = Number of population or movement in year t

r = Average population increase or movement each year

q = difference between projected year and base year

2.5. Road Auxiliary Buildings and Road Supplies

1. Road Auxiliary Buildings

Complementary buildings are buildings that support the road, including bridges, parking lots, culverts, retaining walls, drainage channels, and others.

2. Building Street Equipment

Road equipment is a means intended for safety, security, order, and smooth traffic as well as convenience for road users in traffic. The function of road equipment is used as a tool for the authorities in regulating traffic so that the road can function as well as possible. Analysis of road auxiliary buildings and road fixtures is part of Traffic Engineering Management (MRLL).

1. RESEARCH METHODS

Research methods are the main way used in research to achieve goals and determine answers to problems posed (Nasir, 2008). This research method is carried out based on the following flow chart:

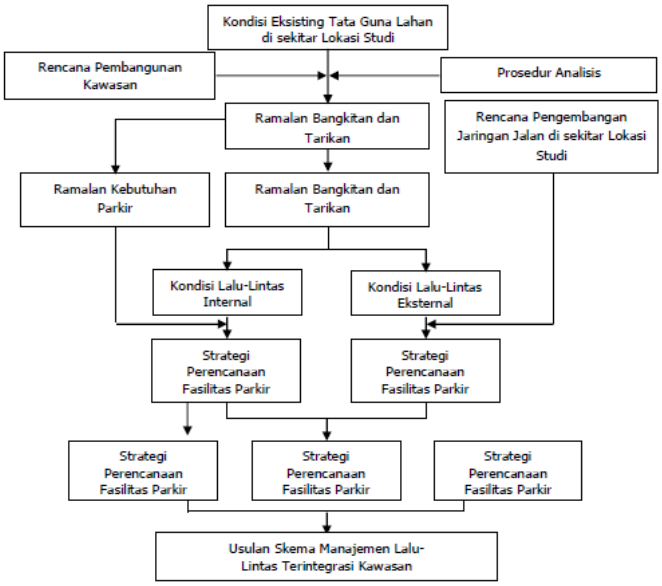

Figure 2. Research Flow Chart

The research methodology is described as follows:

1. Land use conditions of the construction site of the Prof. DR. V. L. Ratumbuysang Mental Hospital is a mental hospital land with a land area of 20,000 m2. Development consists of 2 stages, this research is for phase 1 development.
2. The coverage area of the Study is Kalasey Dua Village on Jalan Kalasey Dua as a development location point with a radius of 1 km.
3. Approximate Transportation used:

a) Traffic Generation and Attraction (*Trip Generation*)

The estimated rise and pull of traffic due to development will put additional strain on the surrounding road network. Things that are done are:

1. Analyze hospital traffic generation and attraction
2. Analyze the coverage of the service area (*catchment area*)
3. Predict and analyze the magnitude of traffic impact for the next 5 years.

b. Parking Demand

Analysis of parking needs using Guidelines for Planning and Operation of Parking Facilities by the Directorate of City Transport Traffic System Development Directorate General of Land Transportation (1998).

4. Establishment of the base year as the basis for analysis.

The basic year in planning, analysis, management, traffic engineering and road transport for the construction of the Prof. DR. V. L. Ratumbuysang Mental Hospital is 2023. The year 2023 is an existing condition for development.

5. Analysis Period.

The analysis period in the analysis of traffic engineering management and road transportation for the construction of the Prof. DR. V. L. Ratumbuysang Mental Hospital is 5 years to 10 years after the construction of the Prof. DR.

V. L. Ratumbuysang Mental Hospital

6. Traffic data collection needs.

Traffic Data Requirements include:

a. Traffic volume during the survey period for 1 week (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday and Sunday). Conduct of traffic flow survey at 06.00 – 18.00 WITA. Data collection in traffic flow surveys to obtain LHR data and *peak hour* data
b. Average speed of the vehicle
c. Public transport data
7. Traffic Engineering Management Needs.

IV.DATA AND ANALYSIS

4.1. Existing Conditions in the Catchment *Area*

The construction site of the Prof. Dr. V. L. Ratumbuysang Mental Hospital is located on Jalan Kalasey – Sea, Mandolang District, Minahasa Regency, North Sulawesi Province, with a land area of 20,000 m2.

The area of influence of RSJ development on traffic is a radius of 1 km from the point of construction location described in Figure 3 below.

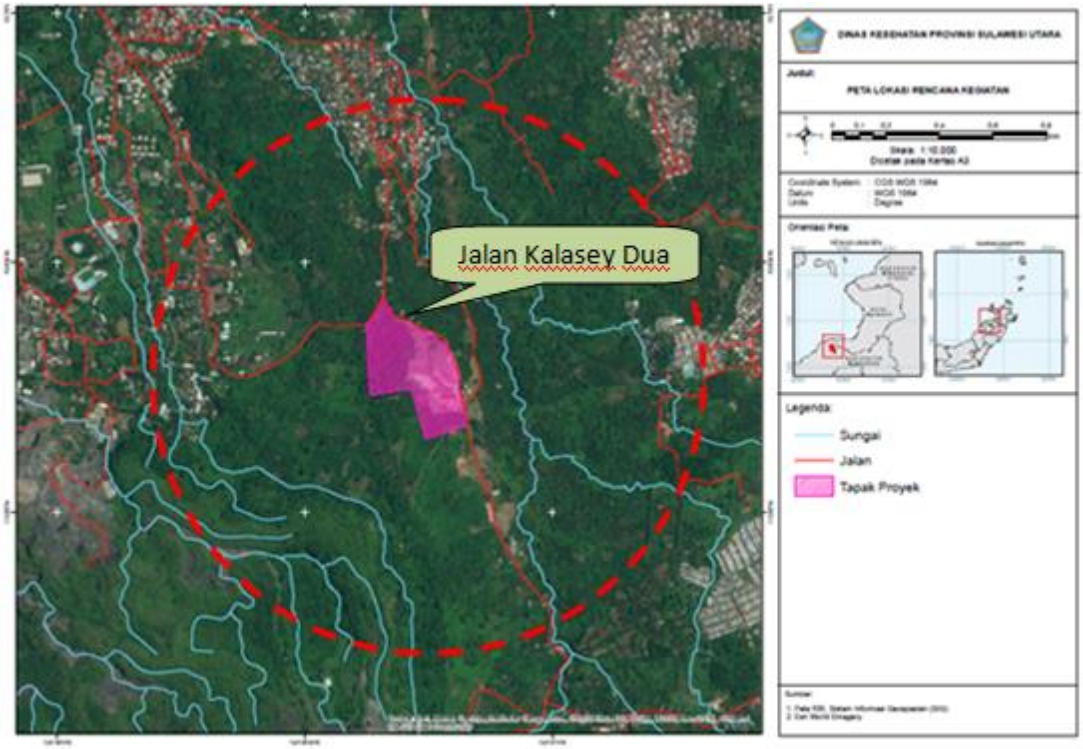

Figure 3. Catchment Area Study Location

The main road section is Kalasey Dua Road section in Kalasey Dua Village. The affected roads are only 1 road with provincial road status.

4.2. **Construction Site Overview**

The construction site of Prof. DR. V. L. Ratumbuysang Mental Hospital has the following buildings:

Stage 1 consists of:

1. Emergency Building
2. Outpatient Installation Building, Pharmacy, Medical Record, Radiology, and Laboratory.
3. Installation Building Inpatient women 1 and management.
4. Installation Building Inpatient women 2
5. Female Inpatient Installation Building 3
6. Installation Building Inpatient male 1
7. Installation Building Inpatient male 2
8. Male Inpatient Installation Building 3
9. Laundry Installation Building
10. Nutrition Installation Building

Stage 2 consists of:

1. Pavilion Building Inpatient male class 1, 2 and VIP
2. Pavilion Building Inpatient women class 1, 2 and VIP
3. Men's visum building
4. Women's visum building
5. Mental Rehabilitation Installation Building
6. Child and Adolescent Mental Health Installation Building
7. House of Worship Building
8. Men's Social Rehabilitation Building
9. Women's Social Rehabilitation Building
10. Male Nurse Dormitory Building
11. Female Nurse Dormitory Building
12. Official House
13. Mortuary Installation Building
14. Cooperative Building and Restaurant
15. IPSRS
16. WWTP
17. Trash Can
18. Power House
19. Water Tank
20. Guard Post.

Prof. DR. V. L. Ratumbuysang Mental Hospital, is a Class B Hospital Regulation of the Minister of Health of the Republic of Indonesia No. 340 / Menkes / Per/III / 2010 concerning the classification of hospitals established in Jakarta on March 2, 2015.

4.3 Kalasey - Sea Road

4.3.1 Kalasey - Sea Road Survey Results

Kalasey Sea road section is a road with type 2/2 UD. The implementation of the traffic flow survey on Monday, March 13, 2023 to March 19, 2023 with a time interval of 06.00 – 18.00 WITA. The peak time during the survey occurs on Monday, March 13, 2023.

Table 2. Kalasey Dua - Sea Road Traffic Flow Data per hour (total 2 ways)

Monday 13 March 2023

O'clock	VEHICLE TYPE				TOTAL
	HV	LV	MC	UM	SMP/JAM
06.00-07.00	5	36	172	0	131
07.00-08.00	5	72	163	0	**162**
08.00-09.00	12	54	152	0	151
09.00-10.00	18	37	84	0	110
10.00-11.00	13	27	67	0	83
11.00-12.00	13	32	97	0	103
12.00-13.00	12	36	90	0	102
13.00-14.00	15	43	89	0	113
14.00-15.00	9	39	71	0	90
15.00-16.00	12	53	94	0	**121**
16.00-17.00	11	34	84	0	95
17.00-18.00	7	24	58	0	65

Source: 2023 survey results

The results of the traffic flow analysis on Monday showed that the busy time occurred in the morning at 07.00 – 08.00 WITA with the number of vehicles 162 junior high school/hour**, and busy afternoon at 15.00 – 16.00 WITA with the number of vehicles 121 junior high school/hour.**

The results of the analysis are described in the form of fluctuations in traffic flow as follows.

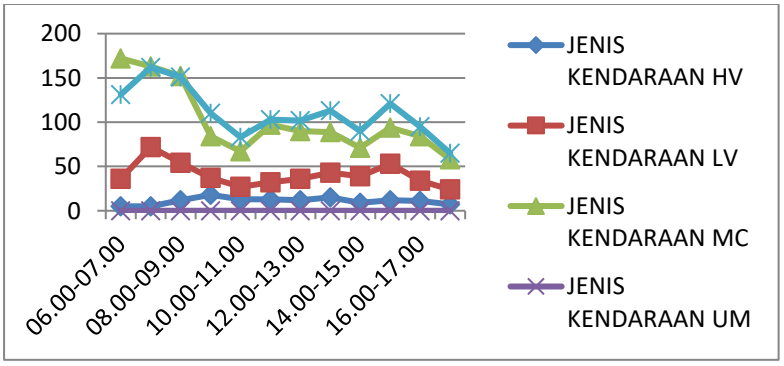

Figure 4**.** Traffic Flow Fluctuations of Kalasey Dua - Sea Road on

Monday, March 13, 2023 (junior high school/hour)

The results of the analysis show that rush hour occurs at 07.00 – 08.00 WITA with the total traffic flow is 162

junior high school / hour.

4.3. 2. Road Section Capacity Analysis

Road section capacity is the maximum flow of vehicles passing through a point on the road per unit hour under certain conditions. Capacity is expressed in units of passenger cars / hour (smp / hour).

The basic equation for determining the capacity of road sections is expressed as follows:

C = CO X FCW X FCSP X FCSF X FCCS.....(Press 2.)

Based on the results of the road section inventory survey, for the Kalasey Dua Road section in Kalasey Dua Village, the road type is 2/2 UD or 2 undivided 2-way lanes.

Road Function : Collector Road

Road Status : Provincial Roads

Road Type : 2/2 UD

Road Width : 5.5 m

Median : None

Number of lanes : 2

Number of Lines : 2

Left Sidewalk : None

Right Pavement : None

Road Condition : Good

Pavement Type : Flexible

Side Obstacles : low

Geometrics of Kalasey Dua – Sea Road, Kalasey Dua Village as shown in the following figure.

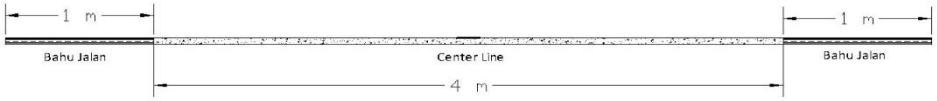

Figure 5. Geometrics of Kalasey Dua – Sea Road, Kalasey Dua Village.

The road capacity calculated based on MKJI 1997 on Jalan Kalasey Dua section is as follows.

Table 3. Kalasey Dua Road Capacity

Street Name	Correction Factors					Total Capacity
	Co (smp/hour)	FCw	FCsp	FCsf	FCcs	
Jl. Kalasey Dua - Sea	2,900 total two-way	0,91	1,00	0,94	0,86	2.134

Source: Analysis results, 2023

1. Service Level Kalasey – Sea Road

The value of the service level is measured based on the value of the Degree of Saturation flow of the road section.

The degree of saturation is the ratio between the volume and capacity of the road section, then

$$DS = \frac{Q}{C} \quad \text{..... (Press 3)}$$

Where: DS = degree of saturation

Q = traffic flow (smp/hour)

C = Road section capacity (smp/hour)

Then = 0.076 $DS = \frac{162}{2.134}$

A saturation degree value of 0.076 indicates the Road Service Level Index, hence the service level

The road is A.

4.5. Movement Generation and Attraction

The transportation system and land *development* are interconnected (Tamin, 2000). The purpose of planning a transportation system is to provide facilities for the movement of passengers and goods from one place to another or from various land uses. The rise and pull of movement is the most important part of this study.

The calculation of trip generation at Prof. DR. V. L. Ratumbuysang Mental Hospital was analyzed based on the number of inpatients at Prof. DR. V. L. Ratumbuysang Mental Hospital at this time which was 170 people and outpatients were 110 people. The current number of rooms is 24 rooms and 200 beds. The number of doctors, nurses and other workers is 372 people.

Mental hospital patients are different from general hospital patients who are often visited by families, so the form of awakening and pulling movements is different. Movement revival occurs mostly for outpatients and general poly. The survey results show that the rise of the movement is as follows:

1. RSJ patients 170 people the number of awakening is 25% = 43 junior high school / day
2. Outpatient and general poly 110 people = 110 junior high school / day
3. Doctors, nurses, other workers 372 people = 372 junior high school / day

The total movement generation is 525 junior high school / day with busy time occurring in the morning at 09.00 – 12.00 wita. According to the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 17 of 2021 concerning the Implementation of Traffic Impact Analysis for the construction of activity centers/settlements/other infrastructure where these activities are calculated to have caused 201 vehicle trips (new vehicles during peak hours and or caused an average of 700 new vehicle trips every day on the roads they affect (new buildings), the category of traffic generation is Medium**.**

Based on this analysis, the results of the estimated traffic generation of Prof. DR. V. L. Ratumbuysang Mental Hospital in 2023, 2028, 2033

Table 4. Estimated Traffic Generation of Prof. DR. V. L. Ratumbuysang Mental Hospital in 2023 phase I

Year	Car (kend/day)	Motorcycles (kend/day)	Smp/day
2023	300	450	525
2028	317	476	793
2033	335	503	838

Source: Analysis Results, 2023

4.6. Road Performance Analysis

4.6.1.Performance of Kalasey Dua - Sea Road Section Without Development and With Development

The performance of the Kalasey Dua - Sea Road section without development is predicted according to the planning year and with the construction with the plan year.

The timeline for the construction of the Prof. Dr. V. Ratumbuysang Mental Hospital is the existing condition in 2023 and the condition of the next 5 to 10 years. Traffic flow analysis will compare traffic conditions in the absence of development and with development. The construction period is in 2023 and the construction will be completed in 2028.

Table 6. Results of the performance analysis of Kalasey Dua - Sea Road Section peak hour period (without construction and with development)

Condition	Year	Total Current Q smp/h	Capacity C smp/hour	Saturation Degree DS=Q/C	Speed km/h
No development	2022	162	2.134	0.076	30
	2027	171	2.134	0.080	30
	2032	181	2.134	0.085	30
With development	2022	172	2.134	0.081	30
	2027	181	2.134	0.085	30
	2032	191	2.134	0.090	25

Source: Analysis Results, 2023

4.7. Traffic Management Needs Analysis

Traffic management is a series of businesses and activities that include planning, procurement, installation, arrangement, and maintenance of road equipment facilities in order to realize, support and maintain security, safety, order, and smooth traffic (PM 96/2015).

1. Construction Period Traffic Management

During the construction period, there is a circulation of freight transportation vehicles that load building materials (materials) from *the quary* to the construction site and heavy equipment used for construction. What needs to be considered at this time is the fall of building materials such as soil and sand transported by vehicles on the road which causes inconvenience to road users in general.

The construction period of traffic flow movement on Jalan Kalasey Dua, Kalasey Dua Village will be disrupted by material vehicles entering and leaving the construction site of the Prof. DR. V. L. Ratumbuysang Mental Hospital so that it is necessary to install traffic signs during the construction period such as:

1. Traffic management during construction phase 1:

a. Careful signs as many as 2 units

b. 1 unit of postal signs

c. Apill signs as many as 1 unit

d. Careful signage in and out of project vehicles as many as 1 unit

e. Entrance signs as many as 1 unit

f. Carwash signs as many as 1 unit.

1. Operational Lifetime Traffic Management

Operational period traffic management for external and internal regions as follows: External Area

1. 1 unit of no-stop sign
2. Careful signs as many as 2 units
3. Apill signs as many as 1 unit
4. Entrance signs as many as 1 unit
5. 1 unit of parking prohibition sign

b). Internal area

1. 1 unit of climbing signs
2. 1 unit of derivative guide signs
3. Right turn signs as many as 1 unit
4. 1 unit of left turn signs
5. There is 1 unit of gathering point signs.

e) Roadside buildings

1. Installation of guard rails on the left side of the entrance

a) Installation of Temporary Signs (Construction)

During the construction period of installation of temporary signs such as:

- Point 1 Kalasey Dua Road – Sea Kalasey Village Two way Kalasey.
- Point 2 Kalasey Dua Road – Sea Kalasey Village Two-way Sea.

Proposed recommendations for impact management are described as follows:

1. Recommendations for Handling the Impact of the Construction Period of Kalasey Dua – Sea Road, Kalasey Dua Village

Table 7. Recommendations for Handling the Construction Period of Kalasey Dua – Sea Road, Kalasey Dua Village

NO	HANDLING	INFORMATION
1	Conducting socialization to the surrounding community regarding the implementation of the Construction of the Prof. DR. V. L. Ratumbuysang Mental Hospital by installing banners around the construction site.	Pre Construction
2	Make special entry and exit access for project vehicles during construction with a minimum width of 6 meters and a minimum radius of 14 meters adjusted to the dimensions of material transport vehicles.	Access
3	Fencing around the construction site.	
4	Installing road safety facilities in the form of: a. Careful signs as many as 2 units b. 1 unit of postal signs c. Apill signs as many as 1 unit	Management and Engineering

NO	HANDLING	INFORMATION
	d. Careful signage in and out of project vehicles as many as 1 unit e. Entrance signs as many as 1 unit f. Carwash signs as many as 1 unit.	
5	Provide a carwash truck vehicle wash location for vehicle washing before leaving the construction site.	
6	Provide a *stockpile / stockyard* location or land to place building materials and equipment to be used for construction within the construction site.	
7	Provide parking locations for transport truck vehicles inside the construction site to avoid parking on the shoulder of the road.	
8	Tightly close the vehicle during material transportation activities using tarpaulins and fastened properly to avoid splattered soil on the road and dust.	
9	Scheduling the transportation of materials outside peak hours, namely at 22.00 - 05.00 WITA. *(specifically for material transportation using large vehicles)*	Scheduling
10	Stop the transportation of materials during rainy weather conditions so as not to splatter on the road traveled.	Scheduling
12	Using the type of project vehicle in accordance with the rules of the road class, where the class of the road around the construction site is class II, the type of vehicle used does not exceed 2,500 mm in width, the display size does not exceed 12,000 mm, the highest size is 4,200 mm and the heaviest axis load is 8 tons.	Types of vehicles
13	Cleaning roads caused by the transportation of materials *(especially soil materials)* during construction.	Miscellaneous

Source : Analysis Results, 2023

Traffic engineering management during construction on the Kalasey Dua - Sea road, Kalasey Dua Village as described in Figure 7 below.

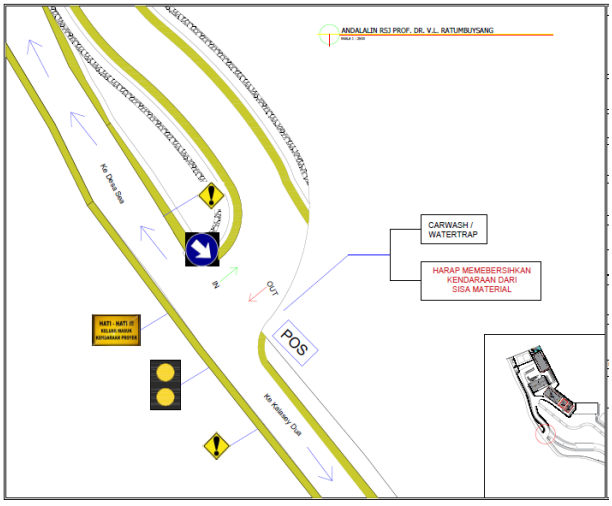

Figure 7. Traffic engineering management during construction on Kalasey Dua - Sea road, Kalasey Dua Village phase 1

a. Kalasey Dua – Sea Road, Kalasey Village

Traffic engineering management operational life as shown below.

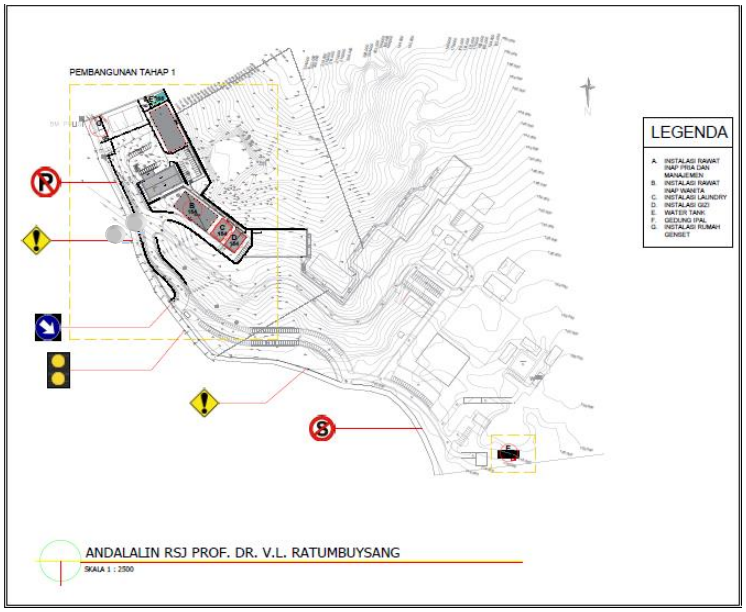

Figure 8. Operational life traffic engineering management

4.7 PROVISION OF ROAD EQUIPMENT FACILITIES

The results of the inventory of existing signs and the need for signs that must be installed internally and externally The construction of the Mental Hospital Prof. DR. V. L. Ratumbuysang is explained in the following table:

Table 8. The Need for Internal and External Traffic Signs for the Construction of Mental Hospital Prof. DR. V. L. Ratumbuysang phase 1

No	Existing Signs		No	Recommended Signs	
	Types of Signs	Sum (unit)		Types of Signs	Sum (unit)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
A	**Jalan Kalasey Dua – Sea**		**A**	**Kalasey Dua Street – Sea**	
			1	No-stop signs	1
			2	Signs of caution	2
			3	Apill Signs	1
			4	Signage	1
			5	No-parking signs	1
	Sum	0		Sum	6
B	**Internal Area**		**B**	**Internal Area**	
			1	Ramp signs	1
			2	Child guide signs	1

No	Existing Signs		No	Recommended Signs	
	Types of Signs	Sum (unit)		Types of Signs	Sum (unit)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
			3	Right turn signs	1
			4	Left turn signs	1
			5	Meet up point signs	1
	Jumlah	0		Sum	5
	Total	0		Total A+B	11

Source : Analysis Results, 2023

4.7.1 Provision of External Area Road Equipment Facilities

The laying of external signs at stage 1 is described in Figure 1.

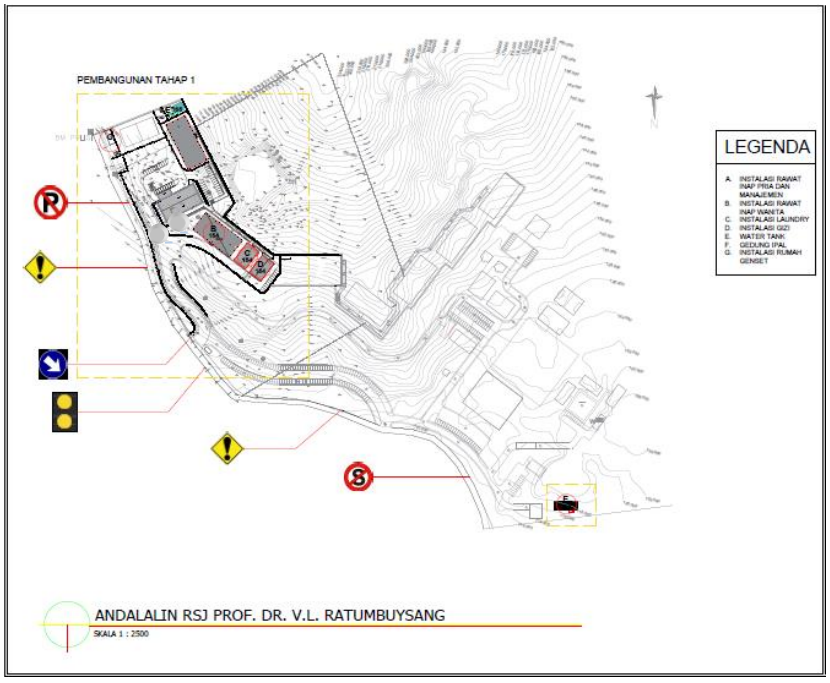

Figure 9. External Traffic Signs Kalasey Dua – Sea Road Section stage 1.

4.7.2 Provision of Internal Area Road Equipment Facilities

The placement of these signs can be seen in the following picture.

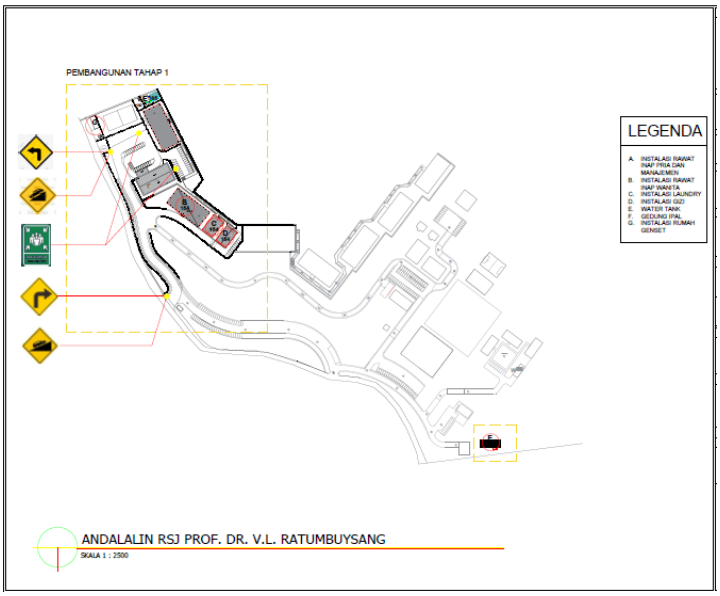

Figure 10. Internal Traffic Signs of Mental Hospital Prof. DR. V. L. Ratumbuysang

The provision of road auxiliary buildings is also required on the driveway ramp. This road is used for vehicles in and out. The condition of the vertical road infrastructure exceeds the requirements of Highways in 2021. Highways in 2021 require a maximum vertical alignment of 8%. Vertical alignments that exceed requirements make road users feel uncomfortable and cause safety disturbances. The countermeasure is the installation of complementary buildings for *guard rail* roads for safety reasons.

V. CONCLUSION AND ADVICE

A. CONCLUSION

The conclusions in this study are as follows:

1. The value of rise and attraction *(trip generation)* is a moderate generation, 525 junior high school/day in 2023.

2. Traffic engineering management on Kalasey - Sea collector road due to the construction of Prof. Dr. V. L. Ratumbuysang Mental Hospital:

- Kalasey Dua – Sea Road: 1 careful sign, 1 Apill sign, 1 entry sign, 1 prohibition sign

- Internal Area: 1 incline sign, 1 descent sign, 1 right turn sign, 1 kumpil point sign. .

B. SUGGESTION

To anticipate the impact of traffic arising from the operation of development, traffic management and engineering are needed. Proposals or recommendations in anticipation of traffic impacts caused.

1. Traffic management and engineering at the time of construction
2. Provision of road equipment facilities
3. Provision of parking facilities
4. Provision of inbound and outbound access
5. Structuring circulation within the area
6. Provision of crossing and pedestrian facilities
7. Provision of other facilities

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