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Original Article

Traffic Management Construction of a Corn Dryer Factory on the Kaiya Maelang Arterial Road, Bolaang Mongondow Regency, North Sulawesi Province

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Abstract *- Traffic management is the process of regulating and using an existing road system to fulfil a particular interest without the need for addition or the creation of new infrastructure traffic. The construction of a Corn Dryer Factory on the Kaiya – Maelang road as a primary arterial road in Tuyat village, Lolak sub-district, North Sulawesi province, is expected to attract traffic which affects road performance around the construction site. Traffic generation caused by infrastructure development is classified as low traffic generation—analysis of traffic generation/attraction using the trip rate factor. The performance of Jalan Kaiya Maelang, Tuyat village, the existing condition is service level A and speed of 40 km/hour. During construction, service level B is 40 km/hour. During the operation period, the performance of the service level road section B has a speed of 35 km/hour. The generation and pull of the movement are predicted to be 91 vehicles per hour. During the operational period of the Kaiya - Maelang road section in front of the corn drying factory, it is necessary to install 1 unit of prohibited parking signs, caution lights, entry signs, stop signs, and caution signs prohibited. Internal traffic control by installing 1 unit of 2-wheel parking signs, 1 unit of 4-wheel parking signs, 1 unit of truck parking signs, 1 unit of exit signs, 1 unit of no-entry signs and 1 parking prohibition sign units.*

Keywords *- Corn mill, Road performance, Trip rate.*

1. Introduction

1.1. Background

The construction of an activity center that attracts or generates traffic at a specific location on the side of the road will impact the surrounding traffic.

Traffic impact analysis is used to predict whether the existing transportation infrastructure in the development area of influence can serve the existing traffic, plus the traffic generated or withdrawn by the construction of the activity center.

The construction of an activity center will impact the surrounding environment, including road traffic. Transportation infrastructure that cannot support traffic must be studied in handling transportation infrastructure in the form of traffic management arrangements.

The construction of a Corn Dryer Factory on the Kaiya Maelang road on the Trans Sulawesi Road, Tuyat Village, Lolak District, North Sulawesi Province, is expected to attract traffic which will affect the performance of roads around the location. Therefore, to calculate the magnitude of the impact of development on existing roads, it is necessary to analyze the impact of traffic so that if it is estimated that a traffic impact will arise, the impact is expected to be minimized and provide the right solution.

1.2. Problem

The problems of this research are:

a) What is traffic engineering management on the Kaiya Maelang primary arterial road due to the construction of a corn drying factory?
b) What is the value of trip generation?

1.3. Research Objectives

The research objectives are as follows:

a) Analyzing traffic engineering management on primary arterial roads due to constructing a corn drying plant.
b) Analyzing the value of the trip generation.
b) Propose forms of traffic management and engineering to improve traffic performance.

1.4. Benefits of Research

The benefits of research are as follows:

a) Provide information to the government and builders to anticipate possible negative impacts of development on traffic performance.

2. Literature Review

2.1. Trip Generation

In carrying out transportation analysis, several calculation models are used. In carrying out transportation analysis, several calculation models are used depending on the data available to be used in the analysis process.

The macro approach begins with an assessment of the land use intensity of the development plan obtained from the developer.

The initial stage of the four stages of the modeling process is trip generation, which in this case corresponds to the shopping area, land use category, and the trip attraction concept is used.

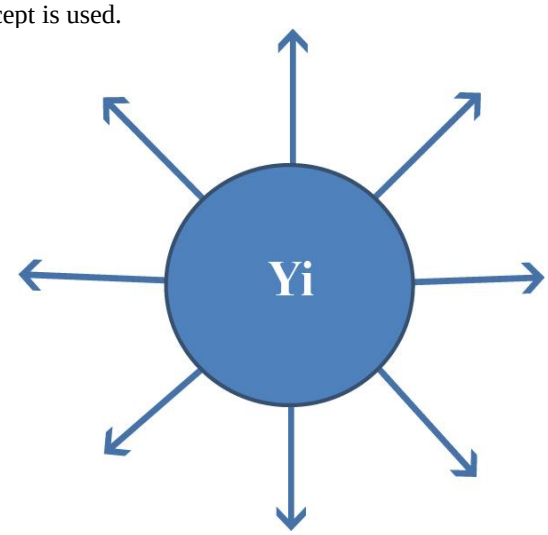


Fig. 1 Trip Generation

2.2. Traffic Characteristics

2.2.1. VC Ratio

VC Ratio is one of the aspects in measuring road performance parameters, where the existing traffic flow is compared with the load capacity.

2.2.2. Speed

Speed is one indicator to assess the performance of a road segment. The value of speed is very influential on the level of comfort on a road segment, where the higher the speed number of a road segment shows good performance.

2.2.3. Density

Density is the ratio between volume and speed expressed in units of pcu/km. Where density indicates the performance of a road segment, the higher the density value of a section indicates poor performance.

2.2.4. Traffic Volume

Traffic volume on the road varies depending on two-way volume, traffic direction, daily volume, monthly volume, annual volume, and the composition of vehicles.

Table 1. Characteristics of Service Level

Level of Service	Characteristics	Scope Limit
A	Free flow conditions with high speed and low traffic volume. The driver can choose the desired speed without a hitch	0,00 – 0,19
B	In the current stable zone. The driver has enough freedom to choose his speed.	0,20 – 0,44
C	In the current stable zone. Drivers are limited in choosing their speed.	0,45 – 0,74
D	Approaching unstable currents where almost all drivers will be restricted. Service volume is related to acceptable capacity	0,75 –0,85
E	Traffic volume is approaching or is at capacity. The current is unstable, with frequent stops.	0,85 – 1,00
F	Forced or jammed current at low speeds. Long lines and big obstacles.	> 1,00

Source: Towards Orderly Traffic and Road Transport, 1996

2.3. Growth Rate

The Population growth rate model is the basis for predicting future vehicle growth:

$$P_{t+q} = P_t(1+r)^q$$

where,
Pt+q = Total population in the year (t+q)
Pt = Total population in year t
r = Average population growth per year
q = difference between projection year and base year

2.4. Parking

Table 2. Size of Parking Space Requirement

Allotment	Unit (SRP for passenger cars)	Parking Space Needs
Trading center		
• Shops	SRP/100 m2 effective floor area	3,5 – 7,5
•Supermarkets	SRP/100 m2 effective floor area	3,5 – 7,5
•Market	SRP/100 m2 effective floor area	1,5 – 3,5
Office Center	SRP/100 m2 floor area	
• Non-public Service		0,7 – 1,0
•Public service		0,2 – 1,0
School	SRP/Student	
Hotel/Lodging	SRP/Room	0,2 – 1,3
Hospital	SRP/Bed	
Cinema	SRP/Seat	0,1 – 0,4

Source: Naasra 1998

2.4.1. Road Auxiliary Buildings and Road Equipment
Road Auxiliary Building

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

Road Equipment Building

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

3. Research Methods

Methods this research was carried out in the following order:

- Data collection on the volume and speed of traffic flow on the Kaiya Maelang road in Tuyat. Village
- Calculating the motion pull generation at the research site
- Analyze the performance of the existing condition of the road, the construction and operation of the corn drying plant
- Propose a form of traffic control during the construction and operation of the corn-drying plant

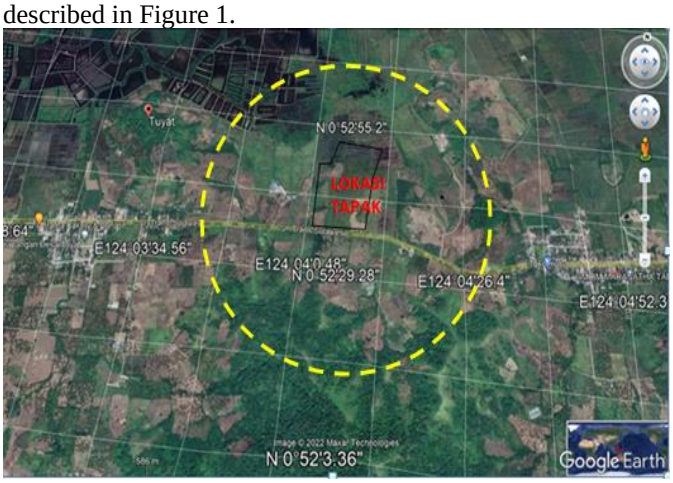
4. Data and Analysis

4.1. Data

4.1.1. Existing Conditions in the Covered Area (Catchment Area)

The construction site for the Corn Dryer Factory is located on Trans Sulawesi road, Tuyat. Village Lolak District, BolaangMongondow Regency, North Sulawesi Province with an area of 39,632 m2.

In this traffic impact analysis, the area of influence has a radius of 1 km from the point of development location, as described in Figure 1.



Source: Google Earth 2022

Fig. 2 Catchment Area Study Location

The main road section is the Trans Sulawesi road (Kaiya – Maelang) in Tuyat village.

Geometric Condition of the Trans Sulawesi Road Section in Tuyat Village, in front of the Corn Drying Factory construction project: the width of the road is 6.00 meters, each lane is 3.00 meters; the shoulder of the road is 2.00 meters, drainage is 1.00 meters.

Description of the Construction Location of Corn Dryer Factory. Minister of PUPR Decree No. 248/KPTS/M/2015 concerning Determination of Roads in the Primary Road NetworkAccording to Their Functions as Arterial Roads (JAP) and Collector-1 Roads (JKP-1), the Kaiya-Maelang section is a Primary Arterial Road (JAP) with a road length of 47.30 km and section number 012. The construction site is located on the Trans Sulawesi road in Tuyat village, Lolak district, BolaangMongondow district, North Sulawesi province with coordinates E 124^0 04^1 0.48^{11} and N 0^o $52^1 29.28^{11}$.

Site Area : 39,632 m^2
Ground floor area: 4,007 m^2
Building Base Coefficient: 10.11%
Building height: 26 m
Number of floors: 1 floor
car park: 50 SRP
motorcycle parking: 50 SRP
truck parking: 20 SRP

4.1.2. Road Traffic Problems Existing Condition

Traffic Problems on the Trans Sulawesi Road The busy time during the survey occurred on Monday, May 9th, 2022. Traffic flow data for the Trans Sulawesi Road ahead of the construction of a corn dryer factory is described in Table 3 below:

Table 3. Traffic Flow Data for Trans Sulawesi Road (2-way total)

O'clock	HV	LV	MC	UM	TOTAL (PCU/HOUR)
06.00-07.00	39	143	76	0	258
07.00-08.00	46,5	153	92,5	0	292
08.00-09.00	67,5	274	171	0	513
09.00-10.00	63	245	121,5	0	430
10.00-11.00	75	112	114,5	0	301
11.00-12.00	43,5	141	98,5	0	283
12.00-13.00	52,5	177	94,5	0	324
13.00-14.00	49,5	143	76	0	269
14.00-15.00	69	130	65	0	264
15.00-16.00	45	138	79,5	0	263
16.00-17.00	45	128	73	0	246
17.00-18.00	43,5	129	65,5	0	238

Source: Survey Results, 2022

The peak hour occurs at 08.00-09.00 with a total flow of 513 pcu/hour. The fluctuation of traffic flow on Monday, 9 th May 2022, is described in Figure 4.7. the following.

4.1.3. Traffic Flow Speed (spot speed)

The traffic flow speed is one measure of road segment performance. Traffic flow speed data is obtained from the results of field surveys using conventional survey methods.

The results of the spot speed measurement, the type of vehicle are light vehicles, can clearly be seen in Table 4. below.

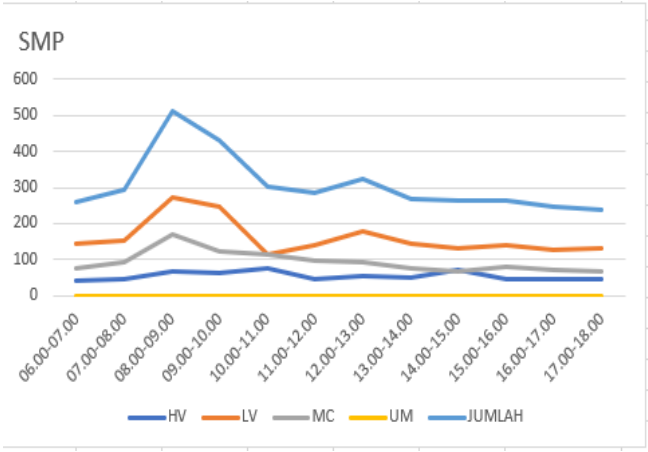


Fig. 3 Fluctuations in Traffic Flow on Monday, May 9th 2022 u/hour)

Table 4. Results of Spot speed Measurements for Private Car Vehicles (LV) on the Trans Sulawesi road in Tuyat. Village

No	Observation time	Speed (km/h)		
		E - W	W-E	Combined Average
1	08.00	42	48	40
2	12.00	40	60	50
3	15.00	50	50	50
4	18.00	52	54	53

Source: Survey Results, 2022

4.1.4. Traffic Flow Density (D)

The density of traffic flow measures the level of road service.

Table 5. Traffic Flow Density on the Trans Sulawesi Section of Tuyat. Village

No	O'clock	Traffic volume (pcu/hour)	Speed (km/hour)	Density (pcu/km)
1	08.00-09.00	513	40	13
2	09.00-10.00	430	40	11
3	12.00-13.00	324	50	7
4	15.00-16.00	263	50	6
5	17.00-18.00	238	53	5

Source: Analysis Results, 2022

The results of the analysis show that the density occurs at the peak hour at 08.00-09.00, which is 13 smp/hour on the Trans Sulawesi road section, Tuyat village.

Table 6. Trans Sulawesi Road Capacity

Road Name	Correction Factor					Total Capacity	Capacity Per direction
	Co (pcu/hour	FCw	FCsp	FCsf	FCcs		
Trans Sulawesi	2.900 total two-way	0,92	1,00	1,00	0,86	2.295	1.147

Source: Analysis results, 2022

4.1.5. Condition of Development Activities (Construction)

The construction of the Corn Drying Factory has a land area of 39,632 m2, a Total building area of 4,007 m2, a maximum building height of 26 m, a Number of floors 1 floor, a Car parking area of 400 m2 (50 SRP); Motorcycle parking area 200 m2 (50 SRP); Truck parking area (15 SRP).

4.1.6. Manpower Mobilization at the Construction (Construction) Stage

The need for human resources at the construction stage of the Corn Dryer Factory, according to the qualifications of experience required, is 100 people; this number is a possible increase or decrease according to the needs of implementing the construction of the Corn Drying Factory

4.1.7. Mobilization of Manpower at the Operational Stage

The need for human resources at the operation stage of the Corn Dryer Factory, according to the qualifications of experience required, is 50 people. This number can increase or decrease according to the operational needs of the Corn Dryer Factory.

Corn dryer factory operating hours are 08.00 to 18.00 for weekdays/weekdays. On Sundays, the only activity is unloading corn. On working days, the activities are unloading, processing and shipping.

4.2. Analysis

4.2.1. Analysis of Road Segment Capacity

Road Segment Capacity

The definition of road segment capacity is the maximum flow of vehicles that pass a point on the road per unit hour under certain conditions. Capacity is expressed as passenger car units /hour (pcu/hour).

The basic equation for determining the capacity of a road section is stated as follows:

$$C = C_O \text{ X } FC_W \text{ X } FC_{SP} \text{ X } FC_{SF} \text{ X } FC_{CS}$$

4.2.2. Vehicle Parking Needs

Analysis of the parking needs of the Corn Dryer Factory is very dependent on the amount of corn needed per day that the corn dryer factory will obtain. The need for corn per day is 300 tons per day with the following analysis:

Corn needs: 300 tons/per day

Factory operating hours: 08.00 – 18.00, 8 working hours per day

Corn demand is 30 tons/hour

The demand for moving corn trucks is estimated at 10 trucks per hour with a capacity of 10 tons.

Analysis of the parking needs of the corn dryer factory is calculated based on the need for corn per day, and the number of employees working during operation is 30-50 people. Parking Space Unit Requirements are:

a. 15 SRP truck

b. 50 SRP car

c. 50 SRP motorcycle

4.2.3. Trip Generation Analysis of Corn Dryer Mill Movement

The hourly rise and tow for the Corn hauling Truck are 15 trucks.

The employee vehicle generation is 26 cars and 50 motorcycles. The entire towing generation is 91 vehicles/hour or 78 pcu/hour.

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 100 vehicle trips (new vehicles during peak hours and or caused an average of 700 vehicle trips). Every day on the affected roads (new buildings), then the traffic generation category is Low Generation.

Table 7. Estimated Traffic Generation for Corn Dryer Factory

Year	Car (car/hour)	Motorcycle (mc/hour)	pcu/hour
2022	41	30	69
2027	48	33	75
2029	56	39	87

Source: Analysis Results, 2022

4.2.4. Performance Analysis of the Trans Sulawesi Road Section in Tuyat Village

Performance of the Trans Sulawesi Road without Development and with Development

The performance of the Trans Sulawesi road segment without development is forecasted according to the planning year and with construction according to the planned year.

Table 8. Results of the analysis of the performance of the Trans Sulawesi Road for the peak hour period (without construction and with construction)

Condition	Year	Total Flow Q pcu/hour	Capacity C pcu/hour	Degree of Saturation DS = Q/C	Speed km/hour
No development	2022	513	2.295	0,22	40
	2027	552	2.295	0,24	40
	2032	639	2.295	0,28	30
With development	2022	567	2.295	0,247	30
	2027	610	2.295	0,266	30
	2032	657	2.295	0,286	25

Source: Analysis Results, 2022

Based on the results of the forecast for road performance with the construction of the degree of saturation in 2022, it is 0.247, and in 2032, it is 0.286.

4.2.5. Comparison of Traffic Performance Simulation

Based on the results of the analysis, it is possible to compare the results of the simulation of traffic performance in each year of observations described in Tables 9 and 10.

Table 9. VCR Road Network

Road Name	VCR				
	2022		2022	2027	
	existing	During construction	After development	No development	With development
Trans Sulawesi	0.222	0.237	0.263	0.24	0.263

Source: Analysis Results, 2022

Table 10. LOS Road Network

LOS				
2022		2022	2027	
existing	During construction	After development	No development	With development
A	B	B	A	B

Source: Analysis Results, 2022

4.2.6. Traffic Management

Construction Period Traffic Management

The construction period of traffic flow on the Trans Sulawesi road in Tuyat village will be disrupted by material vehicles entering and leaving the Corn Drying Factory's construction site, so it is necessary to install traffic signs during the construction period, such as

- APILL warning sign.
- Installation of signs carefully in and out of the project vehicle as much as two pieces.

Operational Traffic Management

Operational traffic management for external areas is as follows:

1. 1 unit no parking sign
2. Caution lamp 1 unit
3. Sign in 1 unit
4. Signs are prohibited from stopping 1 unit
5. 1 unit of caution sign
6. Signs are prohibited from entering 1 unit

Placing Officers to Regulate Traffic Flow

In accordance with the Regulation of the Head of the Indonesian National Police No. 10 of 2012 concerning traffic management under certain circumstances, in this case, the construction of the Corn Drying Factory. It is necessary to regulate traffic during the construction period so as not to interfere with traffic flow on the road.

For the placement of traffic control officers during construction, the developer or builder must coordinate with the BolaangMongondow District Police, requesting assistance from traffic control officers. The placement of officers has a significant impact in order to ensure the smooth flow of traffic on the Trans Sulawesi Road, Tuyat village, in front of the Corn Drying Factory, as well as maintaining smooth access to and from vehicles during the construction period.

5. Conclusion and Suggestions

5.1. Conclusion

The conclusions of this study are as follows:

- The performance of the Trans Sulawesi road segment is service level A, and the speed is 40 km/hour. At the time of construction, service level B was 40 km/hour. During operation, the performance of road section B with a speed of 35 km/hour.
- The total generation and trip attraction caused by the Corn Dryer Factory is predicted to be 91 vehicles per hour.
- Traffic control during the operational period on the Kaiya – Maelang road in front of the corn drying factory: 1 unit prohibited sign, 1 unit traffic light, 1 unit entry sign, 1 unit prohibited parking sign, 1 caution sign unit. Signs are prohibited from entering 1 unit.

Fig. 4 Traffic Management of Corn Dryer Factory Operation

5.2. Suggestion

Anticipating the impact of traffic arising from the operation of the construction required traffic management and engineering. Suggestions or recommendations in anticipating the traffic impacts caused.

1. Traffic management and engineering during construction
2. Provision of road equipment facilities
3. Provision of parking facilities
4. Provision of access in and out
5. Arrangement of circulation within the area
6. Provision of crossing and pedestrian facilities
7. Provision of other facilities

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