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Practical Analysis of the Truck and Bus use of Electro-Mechanical Speed Limiter (SLIFA) Device for Fuel Consumption

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Abstract

The excess speed of trucks and buses is a factor that causes accidents, in addition to the impact on the use of fuel to be wasteful so that operational costs will have a significant effect on fuel needs. In a previous study mentioned several trucks and buses transportation companies. Many install speed limiter that can reduce the potential for accidents by limiting speed, which ultimately has the potential to reduce fuel costs, some of the literature that assembled speed limiter is excessive speed which is directly responsible for the cause of the accident and the level of impact. Reducing speed by 1 km / h can cause a risk of accident 3

Index terms—

1 Introduction

uel is the highest variable cost in the management of operations management in the transportation sector, and another thing is the safety factor becomes the top priority in the continuity of the transportation business [1]. Some truck and bus transportation companies, many install speed limiter that can reduce potential accident by limiting speed, which in the end has the potential to reduce fuel costs, some of the literature assembled speed limiter is excessive and the impact level [2]. Reducing speed with 1 km/h could lead to a 3% fewer accident risk. Accident frequencies and fatality rates increase more than proportionally when speed levels increase [3], especially when a specific speed limit exceeds. Speed reduction is not only to the benefit of road safety but can also reduce fuel consumption and CO2 emissions [4]. The relation between speed and safety rests on two pillars. The first pillar is the relation between collision speed and the severity of a crash.The second pillar is the relation between speed and the risk of a crash. The higher the collision speed, the more serious the consequences in terms of injury and material damage [5]. The purpose of speed limiter is to control the fuel feed into the engine to push the vehicle speed to appropriate speed, which frees up the speed of the vehicle by turning off quickly to reduce the rate of fuel delivery into the engine combustion chamber, when the fuel stops and the breaker relay connects to the accelerator pedal when that speed will decrease gradually if the driver presses the pedal back to the specified limit in the controller motor that mounts on the injection pump [6]. The primary principle function of speed limiter shown in Figure **??**.

2 Speed limiter types based on control technique;

According to Gawad and Mandourah, (2015), there are several types of speed limiter on controlling the vehicle speed. It depends on the adopted technologies. The control techniques such as accelerator control, cable types a motor will control the stroke length of the accelerator pedal linkage to the fuel pump, by attaching the control cable held by the fuel breaker solenoid, the fuel delivery termination will stop very quickly, and this control technique is easy to install because it is only limited to a mechanical system, which can connect to gasoline-based engines or diesel engines, electronic pedal control and direct fuel control (solenoid valve type). The fuel relay engine cut-off for a moment when the speed exceeds the specified limit by adjusting the fuel engine cut-off motor

attached to the fuel throttle, when the driver presses the accelerator pedal to be full and will not change the speed that has been set, that's when the limitation is speed on the vehicle can be achieved.

The survey conducted by the American Transport Research Institute (ATRI) in 2008 consisted of 27 multiple choice questions and was design for 10 minutes of completion time. Primary data collection questions, such as fleet size and type of operation. If the fleet does not use a speed limiter, the respondent is asked to choose one or several reasons because it is underused and does not ask further questions. If the fleet uses speed limiting, the respondent asks about speed limiting in terms of fuel economy perception, fleet safety, driver acceptance, vehicle operations, and related problems [7]. General comments and suggestions, the respondents believe that all information provided will be kept confidential. About 1,500 surveys were approved by e-mail, and 103 were received, the response rate was obtained around 7%. Study-related to fuel economy using a speed limiter, complete, is provided, as shown in Table 1. And Figure **??**.

3 Methodology

To achieve the purpose of this research, we propose a methodology in Figure **??**, and the method consists of the steps of how we install speed limiter SLIFA device on the Truck and Bus.

4 Fig. 3: The Proposed Methodology

5 Truck and Bus Engine Specifications

The following is the specification of the truck and bus engine installed with a speed limiter device, and this specification standard [8], will be compared when it is connected with a speed limiter device to determine the level of fuel consumption savings. In the determination of speed reduction, the speed limiter was divided by inputs frequency value from the speed sensor (a). The speed obtained directly sends a voltage change component, The frequency changes to that voltage are used to provide a trigger to the string that attaches to the position on the side of the engine on the accelerator pedal (b). Each of these inputs served as a trigger to reduce the speed 60 km/h or 70km/h. All restrictions of each velocity based on Vin and Vmax value [9]; the formula for calculating the expected output voltage is in Equation 1.1.Vout = Vcc x f x C 1 x R 1 (1.1)

6 Installation Speed Limiter on the Truck and Bus

The installation procedure of SLIFA to the vehicle shown in Figure **??** Generally, there are three wires that need to be connected to the SLIFA device, which is the signal wire from engine speed, fuel cut off solenoid wire, and ECU wire.

SLIFA installation procedure, as shown in the schematic circuit Figure 2, was performed using the following steps:

1. For diesel trucks and buses, the device was connected to the cable on-brakes of the fuel system as once installed, the existing engine stopped the original motor. 2. After the first point made, it was connected with a cable to the box SLIFA to the process in an electronic circuit and forwarded to the speed sensor on the transmission output. 3. The data pulse from the speed sensor was sent to the speed sensor back and connected to the motor engine stop relay. Installation Digital flow meter Comparison between truck and bus installed and uninstalled (base on standard) by speed limiter performed to investigate the effect of Speed limiter device on fuel consumption, the purpose of this test is how the device and a positive impact other than safety is fuel economy, so this will be able to help the industry in terms of operational efficiency. The digital flowmeter was installed in a high-pressure flexible pipe at the fuel injection pump to monitor fuel flow during driving with various driver characteristics drivers when running the vehicle. The digital flow meter monitoring system shown in Figure **??**.

7 Fig. 3: Digital Flow Meter for Diesel Engine

The fuel will return to the storage tank through a valve over flow. The error increased when more fuel was returned to the tank (when less fuel was burned by the engine) [10]. The worst-case accuracy for any supply to return rate reading combination can be determined by using the following equation 1.2 : Maximum Error = [(0.5% x Supply rate) + (0.5% x Return Fuel)]/ Burn rate (1.2)

III.

8 Result and Discussion

9 Route Test

After installing the speed limiting device and after testing the laboratory scale, they are then checking the laboratory scale with actual environmental requirements, namely by conducting direct tests on the highway with a distance of 138 km with average road conditions or normal road conditions, following the results of the data fuel consumption testing.

10 Fig. 4: Route Test Fuel Consumptions

The test route, as shown in Figure 2, point 1, the maximum speed of the compilation to do the test is 60 km /hr, then many highways on the toll road and in normal road conditions with the degree of great ability do not exceed 9°.

11 Flat Road Fuel Consumption Test

When the flat road test conducted, the speed limiter set to the initial speed limit with a maximum of 60 km/hour by regulations that have been fixed by the Republic Indonesian government through land transportation minister regulation No: 111 of 2015.

From the flat road test results data with the total distance of testing in the toll road area with the length of the test path carried out and with a total of 4 trips usual trip, each trip 34 km with a total of 138.8 km. from the testing shows a very significant fuel consumption reduction from the standard fuel consumption that has been issued by APM on these types and units. The results of the test seen in Table 2 and Figure 4. 2 and Figure **??** flat road test shows that fuel consumption 1:3,12 ltr/km is composed of 1 liter of fuel for trucks and buses with type the engine Table 2, able to work with a distance of 3,12 km with an average speed of 60 km/hour, then if compared to the specifications of the APM can save fuel as far as 1 km with the percentage of effectiveness 80% of the standard value of fuel consumption.

12 Hill Climb Road Fuel Consumptions Test

This test was carried out with a distance of 123.6 km with quite an extreme operation because almost all road conditions that were pass were mountains with grad ability reaching 10 °, when testing the maximum speed was only 50 km/hour and the rpm was quite high with average conditions 1800 up to 2500 rpm.

13 Fig. 7: Route Hill Climb Fuel Consumption Test

From the test data as shown in Table 3 and Figure **??**, fuel consumption in this condition is more wasteful, due to the compilation of 10 ° uphill road conditions requires higher engine run (rpm) compared to the flat ones, from the test results obtained fuel consumption data climbing conditions uphill is 1: 2.19 ltr / km.

14 Conclusion

The results of this study indicate the level of fuel consumption compared to the standard, from the total test mileage (km) to the overall flat test distance 138.8 with a fuel consumption ratio of 1:3,12, then on the hill climb test as far as 123.6 km, with a ratio of 1: 2.19 (ltr/km), from the results of this test, when compared to the fuel consumption standard on the type of truck and bus are 1:2,5 (ltr/km) on flat road conditions and 1.19 on hill climb conditions, then increased fuel consumption by installing speed limiter in truck and bus engines is there a fuel savings of up to 26%, this can change according to the characteristics of the driver in operating it. Then if compared to the specifications of the APM can save fuel as far as 1 km, with the percentage of effectiveness, 80% of the standard value of fuel consumption. The installation of speed limiter devices on truck and bus engines not only for saving fuel but also providing better safety quality and impact the sustainability of the transportation business. With the consumption of fuel-efficient, emissions from combustion may be better, although this needs further research. [1] [2]

[1] Practical Analysis of the Truck and Bus use of Electro-Mechanical Speed Limiter (SLIFA) Device for Fuel Consumption

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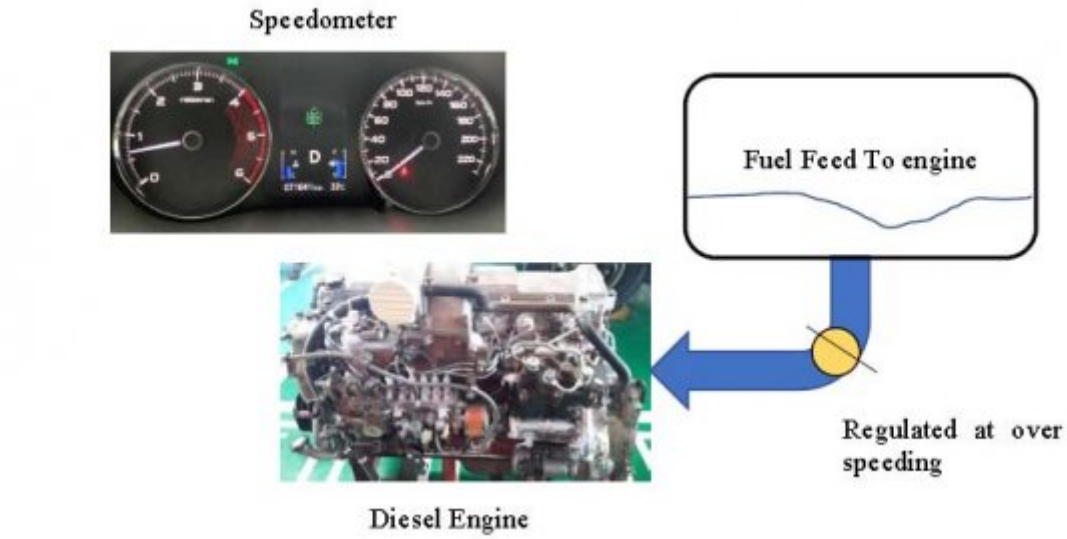

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Figure 1: F © 2020 Fig. 1 :

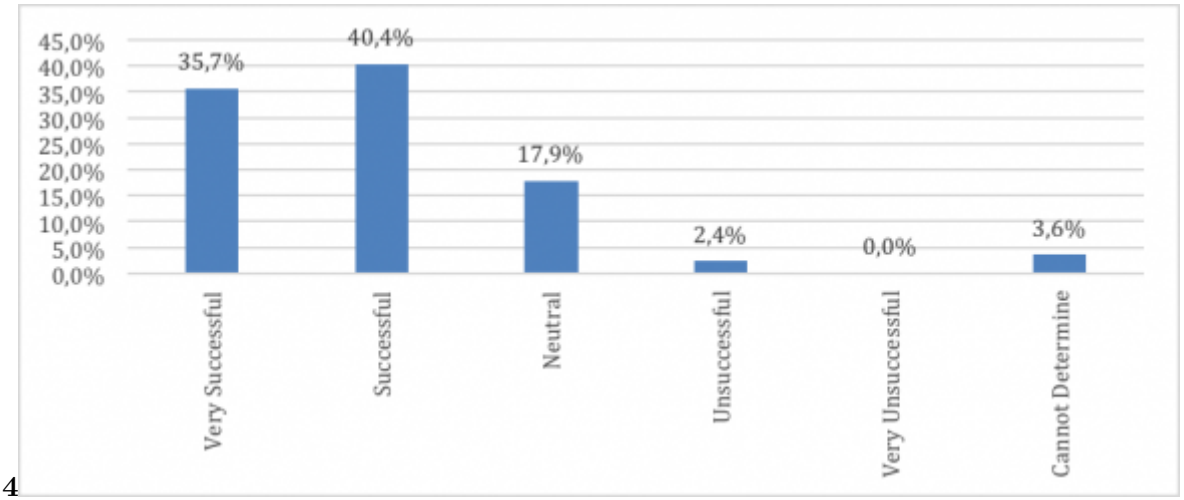

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Figure 2: Fig. 4 :

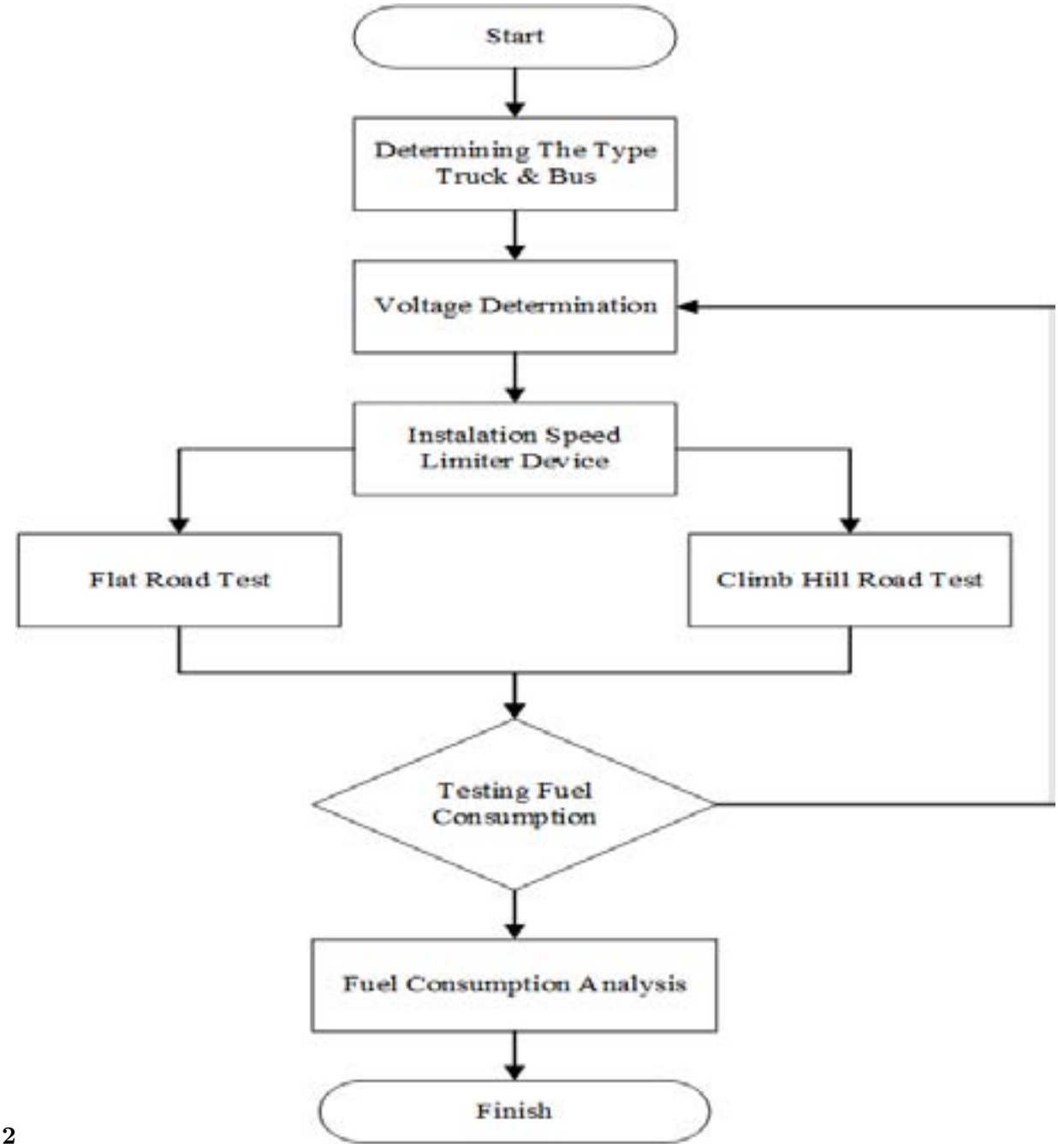

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Figure 3: Fig. 2 :

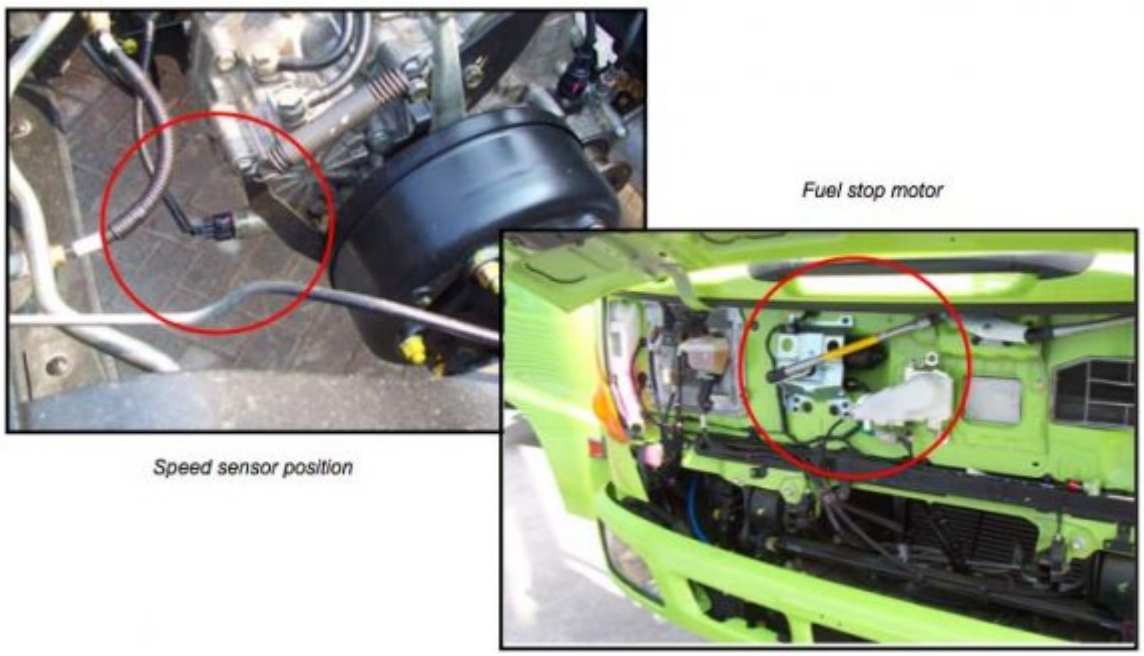

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Figure 4: Fig. 5 :

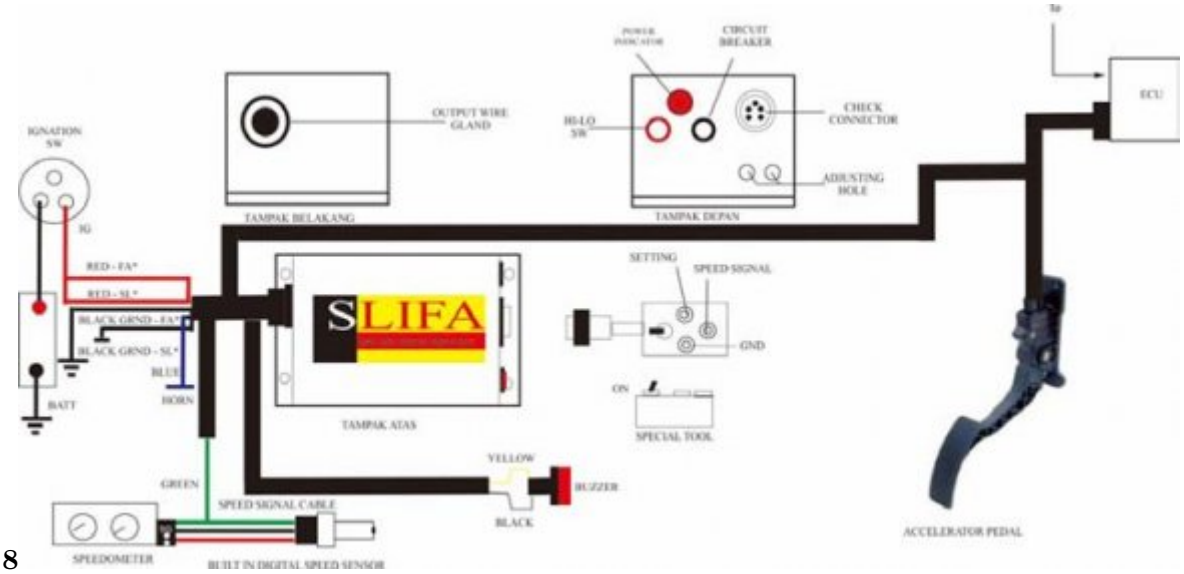

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Figure 5: Fig. 8 :

Figure 6:

1

	Very Successful	Successful	Neutral	Unsuccessful	Very Unsuccessful	Cannot Determine
%	35,7%	40,4%	17,9%	2,4%	0,0%	3,6%
N	30	34	15	2	0	3

[Note: satisfaction of using a Speed Limiter[7] Fig.2: Satisfaction chart of using a Speed Limiter]

Figure 7: Table 1 :

2

[Note: Engine Diesel Engine 4 Stroke Inline Direct Injection 6 cylinder with Turbo Charger Intercooler and Common Rail Mechanism. Power maximum 285/2500 (PS/rpm) Torque maximum 91/1500 (Kg/rpm) Fuel Consumption 1: 2.5 (ltr/km) Performance Maximum speed 105 km/hr and Gradebility 34 (tan%)]

Figure 8: Table 2 :

2

No.	Route	Trip	SG 285 TH Fuel Consumption (L)	Ratio(ltr/km)
1	KBI ~Cikarang Pusat	34,6	9,547	1:3.62
2	Cikarang Pusat ~KBI	34,8	11,3944	1:3.05
3	KBI ~Cikarang Pusat	34,6	11,6918	1:2.96
4	Cikarang Pusat ~KBI	34,8	11,8273	1:2.94
	Total	138,8	44,4605	
Ratio Total Fuel Consumption			1:3.12	

Fig. 6: Route Flat Road Fuel Consumption Test

From Table

Figure 9: Table 2 :

3

No.	Route	Trip	SG 285 TH Fuel Consumption (ltr)	Ratio (ltr/km)
1	KBI ~Buah Batu (High way)	91,4	42,308	1:2.16
2	Buah Batu ~Lingkar Nagrek (General road & High way)	32,2	14,223	1:2.26
	Total	123,6	56,5308	
Ratio Total Fuel Consumption			1:2.19	

IV.

Figure 10: Table 3 :

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