MODELING OF THE WORKING MECHANISM OF THE TRUCK DRYER SYSTEM 130 PS IN SIMULINK-BASED OVERLOAD CONDITIONS

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ABSTRAK

Dalam industri otomotif berbagai upaya peningkatan kualitas kendaraan terus dilakukan, baik dari segi keamanan, kenyamanan, kemudahaan, keindahan, maupun kepercayaan konsumen sebagai pengguna kendaraan itu sendiri. Salah satu sistem yang berperan penting pada kendaraan yaitu sistem pengereman yang berfungsi memberhentikan laju kendaraan. Pada studi kasus ini, ditemukan adanya kebocoran oli rem pada truk 130 PS yang dapat memberikan efek berbahaya untuk sistem pengeremannya. Setelah dianalisis di lapangan, *wheel cylinder* pada komponen rem tersebut pecah yang disebabkan prilaku pengguna itu sendiri seperti adanya kelebihan beban dan kurang tepatnya waktu pengecekan penyetelan rem. Perbaikan dari segi *design* masih dilakukan dan di uji hingga saat ini di PT. HMMI. Salah satu metode untuk mengetahui performa dari sistem pengereman tersebut adalah dengan pemodelan dinamis. Pada penelitian ini dilakukan analisis gaya-gaya kendaraan pada saat pengereman dengan ditekankan terhadap pengaruh slip sampai ban/roda kendaraan berhenti. Pemodelan ini menggunakan simulasi *software* yang membandingkan waktu dan jarak pada saat pedal rem terkena gaya atau ditekan sampai roda berhenti untuk ABS (*Antilock Braking System)* dan LBS (*Lock Braking System)* jika diaplikasikan pada truk 130 PS. Dari hasil analisis dan grafik simulasi disimpulkan bahwa sistem ABS memiliki nilai waktu dan jarak lebih pendek dibandingkan dengan LBS. Diharapkan dengan pemodelan sistem pengereman ini dijadikan referensi pada saat perancangan awal sehingga dapat mengurangi resiko kegagalan komponen yang dapat membahayakan pengguna truk tersebut dan kerugian materi.

.**Kata kunci:** ***sistem pengereman, overload, truk 130 PS, pemodelan Simulink***

ABSTRACT

In the automotive industry, various improvements in the quality of vehicles continue to be carried out in terms of safety, comfort, convenience, beauty, and consumer confidence as the users of the vehicle itself. One of the system that plays an important role in vehicles is the braking system which stops the vehicle's speed. In this case study, a brake oil leak was found in a 130 PS truck which could have a dangerous effect on the braking system. After being analyzed in the field, the wheel cylinder on the brake component breaks down due to user behavior, which is the overload and the incorrect timing of the brake adjustment. Improvements in terms of design are still being done and tested until now at PT.HMMI. One of the methods to determine the performance of the braking system is dynamic modeling. In this study an analysis of vehicle forces during braking is done by emphasizing the slip until the tire stops. This modeling uses software simulation that compares the time and distance on the brake pedal. Restores force or approved stop wheels for ABS (Antilock Braking System) and LBS (Lock Braking System) if applied to a 130 PS truck. From the results of the analysis and assessment of the simulation it was concluded that the ABS system has shorter time and distance values compared to LBS. It is expected that by modeling this braking system it will be used as a reference during the initial design so as to reduce the risk of component failures that can endanger the truck users and material losses

Keywords: braking system, overload, 130 PS truck, simulink modeling

INTRODUCTION

The braking system in trucks is an important part that affects the level of driving safety [1]. A good braking system will protect passengers from several accident risks. The braking system is useful for gently and accurately reducing the vehicle's speed [2]. This is very influential in driving comfort. The use of braking technology

continues to be improved in modern modes of human transportation [3]. Not to forget that energy efficiency is also carried out in the braking system. One of them is the use of dynamos to store braking energy [4]. The goal is to prevent unnecessary energy loss. Computer technology has also begun to be applied in order to get better braking, of course, in terms of safety, comfort and energy saving factors.

Problems that often occur in various automotive components, especially for components with new designs. In Table 1. Below is the aftermarket problem data for 130 PS truck models from July 2017 to July 2019 [5]. In Table 1. This shows that there are 32 cases of complaints about damaged brake components, ranging from leaking oil to broken *wheel cylinder* components (part of the brake). One of the reasons is that truck users do not understand the adjustment of the new brake components to the overloaded truck load which is the main factor [6].

Table 1. List of 130 PS trucks July 2017-July 2019 for brake cases at PT. HMMI

No	No. Mesin (W04DTR)	Nama Pelanggan	Lokasi	Tgl. Pengiriman	Tgl. Kejadian	Jarak Tempuh (km)
1	49157	PT. SMART	Kalimantan Tengah	9-Mar-18	-	-
2	49125	PT. SMART	Kalimantan Tengah	9-Jul-18	-	-
3	52071	PT. SMART	Kalimantan Tengah	22-Jun-18	-	-
4	52073	PT. SMART	Kalimantan Tengah	21-Mar-18	-	-
5	49156	PT. SMART	Kalimantan Tengah	9-Mar-18	-	-
6	49128	PT. SMART	Kalimantan Tengah	9-Mar-18	-	-
7	49144	PT. SMART	Kalimantan Tengah	21-Mar-18	-	-
8	49199	PT. SMART	Kalimantan Tengah	21-Mar-18	-	-
9	49134	PT. SMART	Kalimantan Tengah	9-Mar-18	-	-
10	49094	PT. SMART	Kalimantan Tengah	9-Feb-18	-	-
11	49101	PT. SMART	Kalimantan Tengah	9-Feb-18	-	-
12	49112	PT. SMART	Kalimantan Tengah	9-Feb-18	-	-
13	52094	PT. SMART	Kalimantan Tengah	22-Jun-18	-	-
14	49115	PT. SMART	Kalimantan Tengah	21-Mar-18	-	-
15	49142	PT. SMART	Kalimantan Tengah	10-Mar-18	-	40.879
16	49120	PT. SMART	Kalimantan Tengah	21-Mar-18	-	-
17	49122	PT. SMART	Kalimantan Tengah	9-Feb-18	-	-
18	49199	PT. SMART	Kalimantan Tengah	9-Mar-18	-	-
19	52067	PT. SMART	Kalimantan Tengah	22-Jun-18	-	-
20	52069	PT. SMART	Kalimantan Tengah	22-Jun-18	-	-
21	52093	PT. SMART	Kalimantan Tengah	25-Jun-18	-	-
22	49228	PT. KSL	Kalimantan Tengah	1-Des-17	21-Jan-18	602
23	52742	Jemmy DP	Yogyakarta	21-Des-17	17-Mei-18	8.628
24	54641	Yulian AY	Gorontalo-Sulawesi	30-Apr-18	28-Nov-18	29.138
25	59574	PT. MAT	Kalimantan Utara	22-Des-18	22-Feb-19	19.990
26	51234	Yoppy N	Gorontalo-Sulawesi	14-Des-17	2-Jul-19	4.312
27	44837	PT. LNP	Jakarta	4-Agt-17	17-Jan-18	20.081
28	51772	Bambang TS	Semarang	23-Jan-18	2-Oct-18	32.273
29	44838	PT. LNP	Jakarta	14-Sep-17	9-Jul-18	20.213
30	53591	I Made YM	Bali	10-Feb-18	15-Jan-19	60.059
31	514491	CV. TOP	Bali	3-Nov-17	10-Jan-19	19.084
32	45413	PT. SBB	Bali	31-Jul-17	15-Apr-19	20.950

The focus of this study is to create a model that can describe the condition of the truck's braking system, by entering the numbers that are the input. Simulations can produce images in the form of graphs and figures as well as working mechanisms and energy needs can also be described in this study. The use of matlab applications with simulink facilities is one of the options. The application can be a tool in making calculations based on the data needs owned in addition to saving costs.

In the creation of this braking system model referring to several sources, the researcher formulated various problems that occurred for the truck:

1. What steps were taken to repair the brakes on the truck?
2. How does the load affect truck braking?
3. How much distance is needed for truck braking?
4. What is the condition of the *angular* speed of the wheel against the deceleration of the truck?
5. How does *the* relative slip respond to braking?

These results are expected to be a reference, so that the condition of the truck's braking system is known. This condition is a consideration in improving braking ability or has met safety requirements. It can also describe the truck's level of safety in a variety of load variations and certain conditions

RESEARCH METHODS

Direct observation was also carried out both at PT. HMMI in the Purwakarta area, a vendor that assembles brake components as well as truck users in the field carried out by several. One example of a truck that has a leak as shown in figure 1. follows.

Figure 1. One example of a truck that has a brake oil leak

Materials

The needs and desires of truck drivers in the Purwakarta area are collected, analyzed, and then modeled in simulink blocks. The results of observations are carried out continuously to complement the data that has been obtained and then refined into a new mathematical model. After the model block is formed, one of the parameters is applied, namely the amount of load to be moved, This final result is then analyzed in energy needs and predicted the economic value in accordance with the old technology that has been applied.

Tools

In this study, a computer with I7 core specifications with Windows 7 OS, which has the Matlab 2015 Application and is equipped with Tools Simulink, mathematical formulas and models according to the latest data are entered into the Matlab application. The simplification method used is to select the appropriate *liblary* simulink library. The matlab application used is ver 2015 because of the more complete features.

Materials Tested

One of the components that has undergone design changes is checked how the conditions in terms of assembly and actual conditions in the field have been monitored continuously until now ± for 3 months. This mathematical model is then analyzed in terms of its energy consumption needs. Improvements were made to the model according to the latest data obtained. After it is believed that the model made is quite feasible, predictions of economic feasibility at the cost of using current technology are carried out.

RESULTS AND DISCUSSION

Actual Condition Improvement Results

Because of the behavior of truck users, namely indications of overload during operation, it causes the brakes to be often used, but for *adjusting the brake shoe*, sometimes the user is not on time, causing damage to the brake components. The damaged component is the *wheel cylinder* because the position of the locking lever has passed through the adjustment gear, causing the component to break. As for the use of public transportation or travel and use in the city until now there have been no complaints about the brake components.

Modeling and Simulation Results

Truck modeling using simulink simulation with MATHLAB has three load variations, namely an empty truck load of 2.5 tons, a normal truck load of 5 tons, and an *overload load* of 6.5 tons. These values are obtained from the truck specifications at PT. HMMI and survey results in the field.

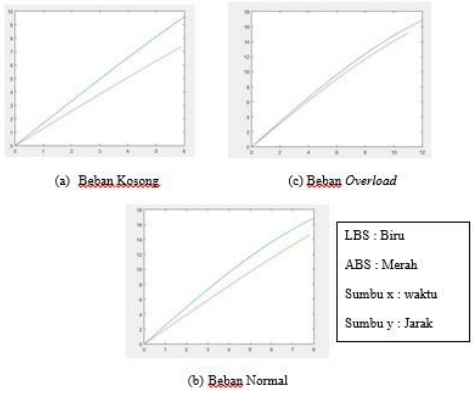

Figure 2. Braking time and distance between LBS dan ABS

From the simulation results in Figure 2. above, it is found that the amount of braking distance required by vehicles with the ABS braking system is shorter than the LBS braking system, this can be seen in tests with truck conditions on empty loads, normal loads, and *overload* loads. In addition, the braking time required for each variation of loading conditions in trucks with an ABS braking system is shorter when compared to the LBS type braking system. Furthermore, it is also obtained that the braking distance in vehicles with an ABS braking system is better than the LBS braking system.

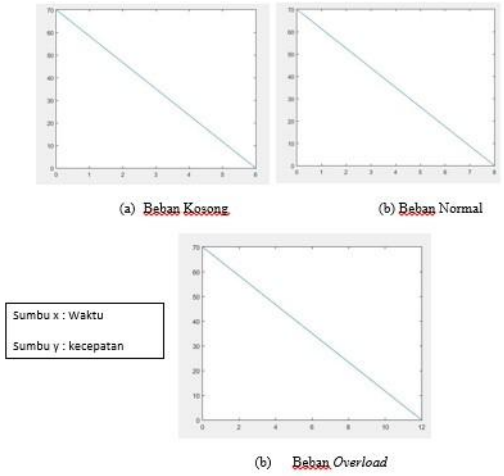

Figure 3. Graph of the angular speed of the wheel system
LBS

In figure 3. above it can be seen that the wheels in the LBS system lock instantly against time and do not show speed fluctuations, therefore it can be said to have a slip of 100% with a speed of 40 km/h and a variation of three loads, namely empty, normal and *overload*

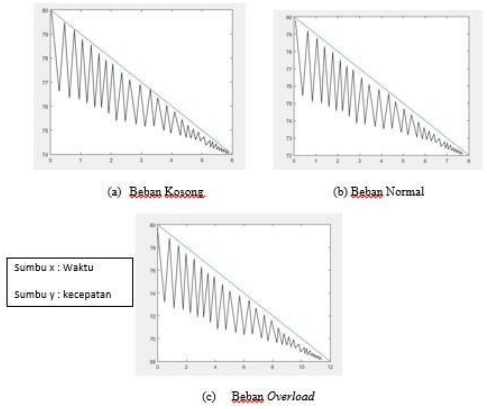

Figure 4. ABS system wheel angular speed graph

In figure 4. above for angular wheel speed model ABS system with wheel rpm of 11.11 m/s or 70 rpm then due to fluctuations from the wheel experiencing a slip reduction of 70 % to 6, 8 and 12 seconds until the wheel stops.

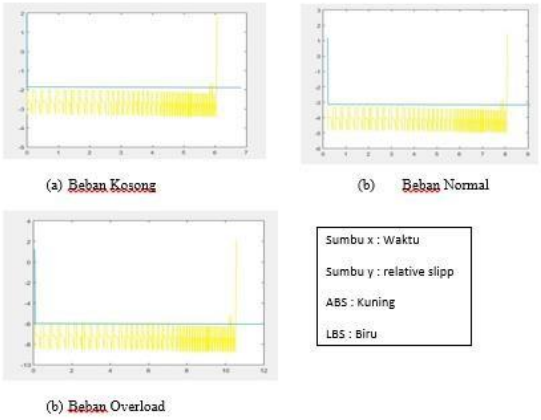

Figure 5. Relative slip between ABS and LBS.

From these results, it can be concluded that the response of the ABS braking system is better than the LBS braking system, this is in accordance with the existing theory that when the ABS works, the amount of braking force is released. From the results of the simulation in figure 2. above, it was found that the amount of braking distance required by vehicles with the ABS braking system was shorter than the LBS braking system, this can be seen in tests with truck conditions on empty loads, normal loads, and overload loads. In addition, the braking time required for each variation of loading conditions in trucks with an ABS braking system is shorter when compared to the LBS type braking system. Furthermore, it is also obtained that the braking distance in vehicles with an ABS braking system is better than the LBS braking system.

CONCLUSION

From modeling with data analysis and simulation, this study resulted in a conclusion that the LBS braking system has a longer braking distance compared to the ABS system at different load variations so that the ABS system is better compared to LBS. With three loads, namely the weight of the empty load plus the driver of 2.5 tons, the normal load taken from the results of the survey in the field is an average of 6.5 tons, Meanwhile, the maximum permissible

weight is around 8.25 tons but the actual in the field reaches 11 tons (*overload).* ABS has a shorter distance value compared to the LBS system for the results can be seen in the graph of figure 2. You can see how the LBS working system where the wheels are directly locked 100% while the ABS working system is about 70%~95% of the data taken from the previous journal. The simulation results can be seen from the graph of figure 3. LBS and picture 4. ABS. You can see the relative slip comparison for the LBS and ABS systems where the ABS slip value is better compared to the LBS system, can be seen in the graph of figure 5.

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