PERFORMANCE OF DUAL HYDRAULIC CYLINDER OF LIFTER SYSTEM FOR 6X6 OIL PALM FRUIT BUNCH TRANSPORTER VEHICLE

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ABSTRACT: Lifter system is one of the most important device for oil palm fruit bunch transporter vehicle. It provides mechanism of unloading the oil palm fruit bunch from the steel bucket of the vehicle. Because of that, the aim of this study is to evaluate the performance of this lifter system using dual hydraulic cylinder. It had been carried out by simulating the system using FluidSim software and comparing the results with the theoretical calculation. The main parameters under investigation were the extending and retracting speeds, and also the ability of the system to provide fast operation of reaching the maximum cylinder stroke. The results from simulation showed that this system was able to achieve maximum speed of 0.085 m/s during extending and 0.145 m/s during retracting. These velocities were much slower than the calculated theoretical results. It was due to the losses of the system, which had been incorporated in the simulation analysis by including all major operating components. In conclusion, this system is able to provide fast operation under maximum loading condition and in repetitive cycle. It also shows that system losses can potentially affect the overall performance of hydraulic system.

KEYWORDS: *Lifter System; Hydraulic Cylinder; 6x6 Transporter*

1.0 INTRODUCTION

Malaysia is one of the largest producer of palm oil in the world. Because of that, big oil palm plantations require an effective method of transporting oil palm fruit bunch to the processing plant. The use of 6x6 transporter is crucial especially in maneuvering the heavy loads on the uneven and hilly road surface (Deraman et al., 2013).

These heavy loads are commonly transported using a steel bucket, which is equipped with the vehicle. It requires an effective lifter system during the unloading process. This lifter system is used to tilt the steel bucket at certain angle that allows the loads to be unloaded from the vehicle (Shuib et al., 2009). Most of the lifter system is using hydraulic system, which is proven to have the ability to withstand large forces and its robust attribute.

It is also a matured technology and easy to maintain. Even though there are a lot of hydraulic system configurations that are available, the most popular setup for a lifter system is double cylinder system (Prakalp et al., 2017; Borikar et al., 2012). Because of that, the aim of this study is to evaluate the performance of double cylinder lifter system for a 6x6 transporter vehicle.

The main parameter that is going to be investigated is the travelling speed of the cylinder (Henikl et al., 2012). It will provide justification whether this system can be effectively used to lift the heavy

payloads.

2.0 RESEARCH METHODOLOGY

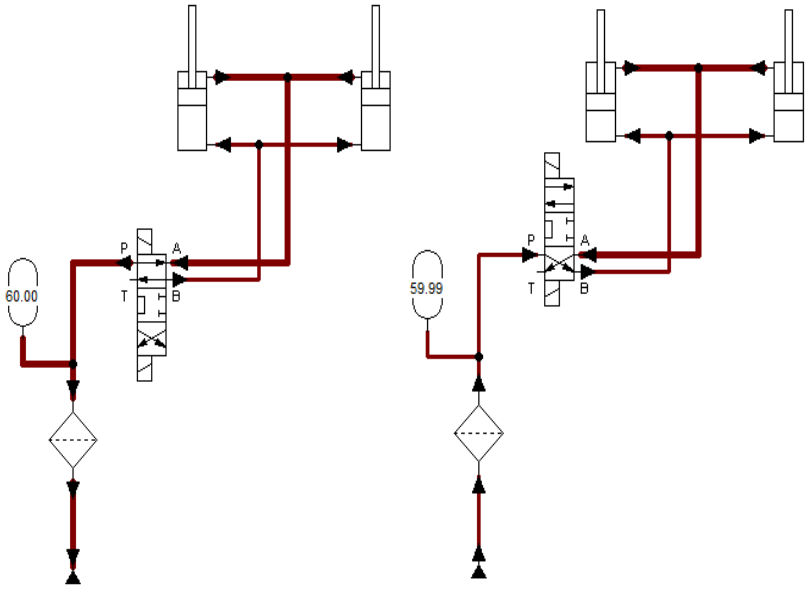
The initial phase of this study was determining the lifter operating parameters. It had been set based on the design configuration of the 6x6 transporter vehicle and the maximum payload. Details of the parameters are listed in Table 1 below.

Table 1 Lifter System Parameters

Parameter	Value
Load Capacity	2200 kg
Cylinder Diameter	13 cm
Maximum Stroke	50 cm
Pressure Relief Valve	90 bar
Volume Flow Rate	85 lpm

Next, the travelling operating speed of the hydraulic cylinder was calculated theoretically. It included both speeds, namely extending and retracting speeds. These theoretical speeds became the baseline performance of the system. Unfortunately, it did not mimic the real operating condition of the system, in which losses were normally occurred in the system equipped with multiple components.

Because of that, simulation approach was introduced, which able to portray the complete operation of hydraulic system. For the purpose of this study, FluidSim software was used and the hydraulic circuit was shown in Figure 1 below.



(a) (b)

Figure 1 Dual Cylinder Hydraulic Open Circuit System during (a) extending and (b) retracting

3.0 RESULTS AND DISCUSSION

Figure 2 below displays the results of simulation using FluidSim software. This system is able to provide maximum stroke of 0.5 m in order to tilt the steel bucket of the transporter. It also shows consistent cycle based on the cylinder position. This consistency attribute is an important criterion because the system is expected to operate in repetitive mode.

The maximum recorded velocity during extending is 0.085 m/s, which means that it requires around 6s to be fully extended. During retraction, the maximum recorded velocity is 0.145 m/s. It requires around 3.5s for the system to return back to the resting position. The fast operation of tilting the bucket when it is fully loaded is also an important requirement of the transporter system.

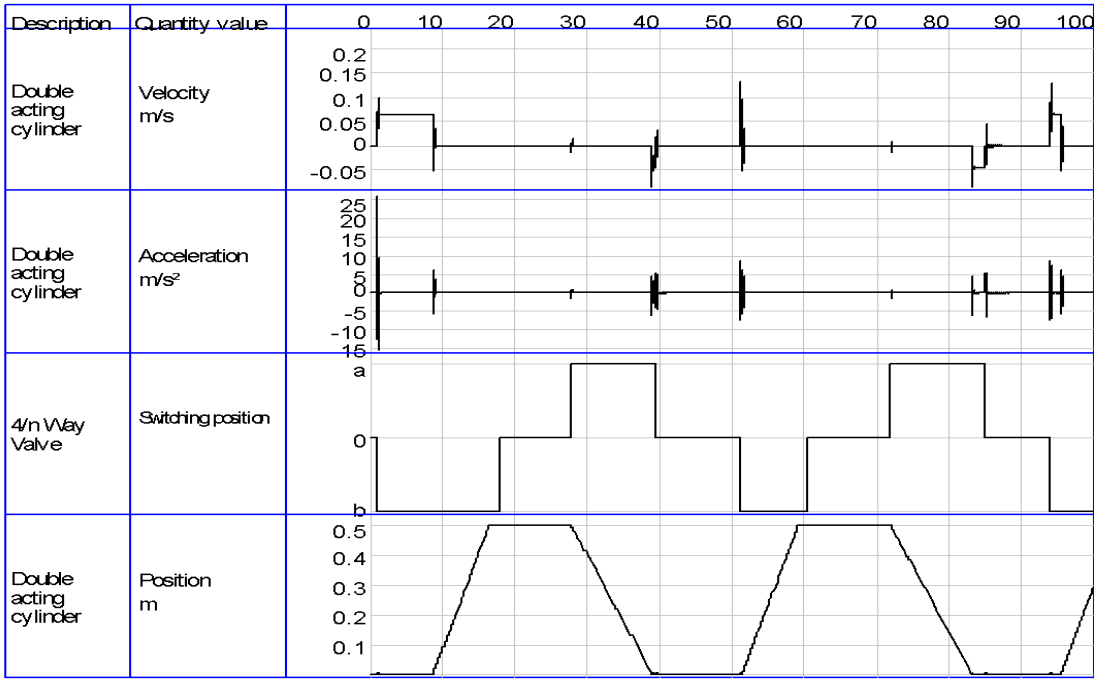


Figure 2 State Diagram of Open Circuit Hydraulic System

Table 2 below provides the comparison of the extending and retracting velocities of the cylinders between theoretical and simulation. For both conditions, simulation results show slower speed than the theoretical calculation. The main reason of this occurrence is due to the losses of the system. The simulation results are based on the constructed hydraulic circuit, which takes into account all the related functioning components such as hoses and valves.

It causes the system to have slower maximum velocity of the cylinder operation. Even though theoretical calculation is able to provide initial information regarding the system's operation, but it does not able to portray the real operating condition of the system.

Table 2 Comparison Between Theoretical and Simulation Results

Parameter	***Theoretical***	***Simulation***
Extend Velocity(m/s)	0.107	0.085
Retract Velocity(m/s)	0.262	0.145

4.0 SUMMARY

The aim of this study is to evaluate the performance of lifter system using dual hydraulic cylinder that had been equipped in 6x6 palm oil fruit bunch transporter vehicle. The main parameters under investigation were the extending and retracting speeds of the cylinder, and also the ability of the system to work under repetitive cycle with maximum payload. The simulation had been carried out using FluidSim software and it produced maximum extending speed of 0.085 m/s and

maximum retracting speed of 0.145 m/s. These values were much smaller as compared to the calculated theoretical values, which were due to the losses of the system. It was because, simulation approach had taken into consideration about the losses of all operating components. Despite of that, this system was still able to provide fast operation under maximum loading under repetitive cycle.

5.0 REFERENCES

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