CONCEPTUAL DESIGN OF 6X6 OIL PALM FRUIT BUNCH TRANSPORTER VEHICLE LIFTER SYSTEM

A. Md Saad[1], M.S.A.M. Rahadi[1], M.A. Salim[1,2], F. Ahmad[1], M.R. Mansor[1], M.Z. Akop[1] and N.A. Masripan[1]

[1]Fakulti Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

[2]Advanced Manufacturing Centre, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

Corresponding Author's Email: [1]adzni@utem.edu.my

ABSTRACT: The 6x6 oil palm fruit bunch transporter vehicle is designed to assist in transporting oil palm from the farm to the processing plant efficiently. Because of that, this specific function vehicle must be equipped with lifter mechanism in order to facilitate the process of loading and unloading the oil palm fruit bunch. In general, lifter system consists of bucket and lifting mechanism, in which both components must be able to work effectively. Because of that, the aim of this paper is to determine the best conceptual design of lifter system that is going to equipped in the new vehicle design. Three conceptual designs were produced based on the benchmarking process. Existing lifter systems that available in the market were investigated. Then, Pugh method was used in order to obtain the best design. Seven evaluation criteria were listed and scored for each of the conceptual design. These designs were later ranked based on the total score. The conceptual design 3, which obtained the highest rank was chosen as the best design and proceeded with detailed design and fabrication processes. It consisted of u-shaped steel bucket design and two hydraulic cylinder with four-level adjuster as the lifting mechanism.

KEYWORDS: *Lifter System; Conceptual Design; Pugh Method*

1.0 INTRODUCTION

The new design of 6x6 oil palm fruit bunch transporter vehicle starts with visualizing the idea into sketch drawing (Deraman et al., 2013; Mansor et al., 2016). This process requires the input and guidelines in order to meet the end requirements of the vehicle itself. For the case of designing the lifter system, the input is based on the existing systems that currently available in the market. In general, all the lifter systems consist of the bucket and lifting mechanism (Prakalp et al., 2017).

For the bucket design, it has to be simple but able to carry the maximum load and provide protection to the oil palm fruit bunch especially when the vehicle is moving on rough terrain. It this study, the maximum allowable load is 700 kg (Deraman et a., 2013). On the other hand, lifting mechanism is required during the unloading process. It tilts the bucket at certain degree to unload the oil palm fruit bunch. There are various designs of lifter mechanism that have been used by many transporter vehicles. Mostly, manufacturers prefer to use hydraulic, pneumatic or mechanical linkages. These mentioned systems are well known as matured technologies and have proven capabilities in terms of reliability and robustness.

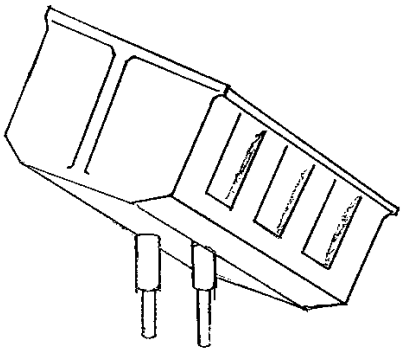
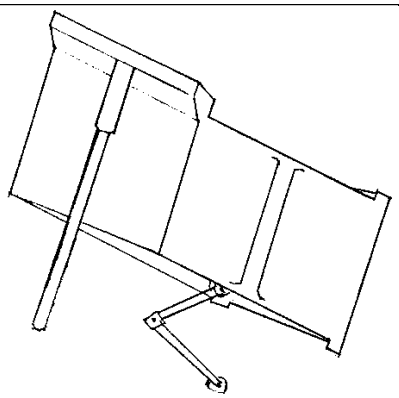
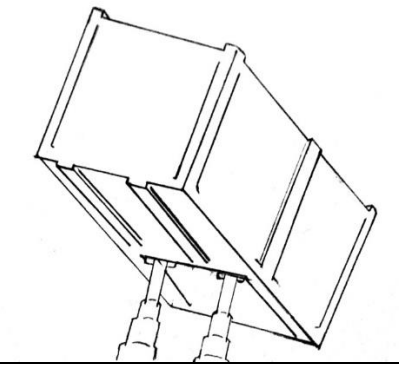
The main criteria of this lifter system is the ability to withstand heavy load and moving it in shortest possible time. The estimated load that needs to be carried by lifter system in this study is 2200 kg (Shuib et al., 2009). It includes the mass of the bucket and maximum load. Based on that, conceptual

designs of lifter system are produced. The selection process is carried out systematically by using Pugh method (Dange et al., 2018). It makes the decision making process becomes more objective instead of depending on the subjective opinions.

2.0 RESEARCH METHODOLOGY

There were three conceptual designs of the lifter system that had been sketched. They consisted of steel bucket to carry the load and lifting mechanism that used to tilt the bucket. For the first concept, the design utilized U-shape bucket design and hydraulic cylinders as the lifting mechanism. The second concept used box-shaped bucket design and mechanical linkage as lifting mechanism. The final design employed box-shape bucket and two hydraulic cylinders with four-level adjuster. Table 1 below shows the details regarding the conceptual designs.

Table 1 Conceptual Designs of Suspension System

No	Conceptual Designs	Justifications
1		1. Use U-shape of bucket. 2. Difficult to manufacture due to complexity to maintain the symmetrical geometry. 3. Use two hydraulic cylinders as lifting mechanism. 4. Ease the loading and unloading operations, hydraulic cylinder only withstands half the force.
2		1. Use box-shape of bucket. 2. Easy to manufacture; lower cost 3. Use mechanical linkages as lifter mechanism. 4. Complex to install with high fabrication cost. 5. Use telescopic cylinder at the front to support the lifting mechanism
3		1. Use box-shape of bucket. 2. Easy to manufacture, lower cost. 3. Use two hydraulic cylinders as lifter mechanism. 4. Four-level adjuster of hydraulic cylinders

3.0 RESULTS AND DISCUSSION

In selecting the best conceptual design, Pugh method was used. Seven different criteria were evaluated, which related to overall design of the lifter system. They can be decomposed, scored and

summed to gain the total score. Then, each conceptual design can be ranked. For this particular approach, the criteria were not weighed to ensure a quick selection process. Table 2 below shows the tabulated data of the Pugh method for the lifter system.

Table 2 Pugh Method of 6x6 Vehicle Lifter System Conceptual Design

Criteria	**Concept**			
	Datum	1	2	3
Performance	0	+	1	+
Ease of Installation	0	-	-	+
Ease of Maintenance	0	-	-	+
Safety	0	1	1	1
Cost	0	-	+	-
Manufacturability	0	-	-	+
Material	0	1	1	1
Sum of '+'s	0	1	2	4
Sum of '1's	0	2	3	2
Sum of '-'s	0	4	3	1
Net Score	*0*	*-1*	*2*	*5*
Rank	*0*	*3*	*2*	*1*

The results show that conceptual design 3 obtains the first rank. Because of that, this concept is chosen as the lifter system configuration for the new 6x6 oil palm fruit bunch transporter vehicle. It means that this design can deliver the most valuable criteria as compared to other alternatives. Detailed design and fabrication processes were proceeded based on this selected conceptual design.

4.0 SUMMARY

The aim of this study is to select the best conceptual design of lifter system that is going to be equipped in the new 6x6 oil palm fruit bunch transporter vehicle. The initial process of conceptual design was based on the benchmarking process in order to investigate the systems that had been used by existing vehicle. All the conceptual designs consisted of steel bucket design and the proposed lifting mechanism components. A total of 3 conceptual designs were produced that had different configurations of bucket design and type of lifting mechanism. Then, the best design was chosen by using Pugh method. Evaluation criteria were listed and the conceptual designs were ranked based on the obtained score. The first rank, which was conceptual design 3 was chosen as the best conceptual design. This design used U-shape steel bucket and dual hydraulic cylinder with four-level adjuster. It was then proceeded with detailed design and fabrication processes.

5.0 REFERENCES

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