

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

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ABSTRACT: The design and development of new products including vehicle design and its subsystems start with the conceptual design process. It translates the initial idea into practical products. For the purpose of designing 6x6 oil palm fruit bunch transporter vehicle suspension system, the same approach is utilized. Because of that, the aim of this study is to select the best conceptual design of suspension system for 6x6 oil palm fruit bunch transporter vehicle. This conceptual design was based on three axle vehicle. It started with the benchmarking process in order to investigate the suspension system that had been used by existing road vehicle. Based on that, three conceptual designs that using different types of suspension configuration were produced. The details advantages of every configuration were listed. Then, Pugh method was utilized in order to choose the best conceptual design systematically. Evaluation criteria were listed and weightage of importance was assigned for every criterion. Based on the results, conceptual design 3 that achieved the highest score was chosen as the best conceptual design. This design used MacPherson strut suspension for all 3 axles.

KEYWORDS: *Suspension System; Concept Design; Pugh Method*

1.0 INTRODUCTION

The production of oil palm industry particularly in Malaysia is facing fierce competition by other comparable crops products (Deraman et al., 2013). Because of that, the efficiency of palm oil production must be increased including the way of transporting the crops from the farm to the processing plant in order to overcome this challenge. It causes constant demand of new transporter vehicle design (Shuib et al., 2009). The initial process of designing and developing new 6x6 oil palm fruit bunch transporter vehicle starts with conceptual design (Mansor et al., 2016).

It consists of designing all the vehicle subsystem including the suspension system. Benchmarking process is carried out to investigate the existing design of suspension system that has been used in the market. In general, there are various types of suspension that have been utilized in various types of road vehicles such as leaf spring, beam axle, MacPherson strut, multi-link, double wishbones and many more (Md Saad et al., 2016). Because of that, it is crucial to choose the best type of suspension in fulfilling the specific requirement of vehicle design.

Systematic approach is also needed in selecting the best suspension configuration conceptual design such as Pugh method (Dange et al., 2018). It eliminates the error of selecting the best design that is only based on the personal or emotional preference. Based on the above mentioned reasons, the aim of this study is to select the best conceptual design of suspension system for 6x6 oil palm fruit bunch transporter vehicle.

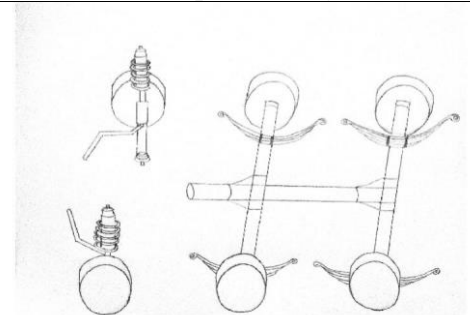
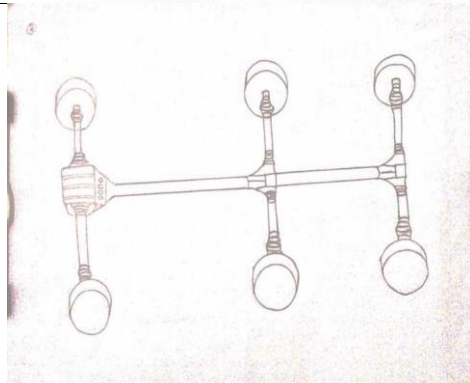
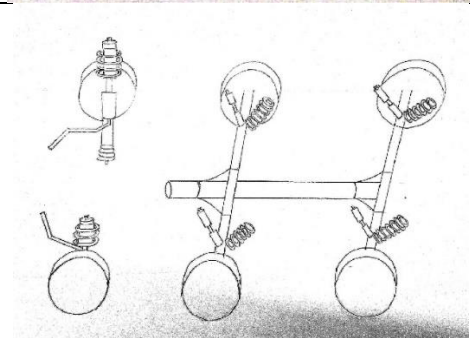
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DOLOGY

There were three conceptual designs of the suspension system that had been sketched. It was based on 3 axles configuration of vehicle. For the first concept, MacPherson strut was designed at the front suspension while for the middle and rear suspension, two sets of leaf spring were designed for each axle. The second concept was designed based on swing half-axle at all axles.

For the final concept, MacPherson Strut was designed at the front axles and both rear axles were designed with spring and absorber. Table 1 shows the justification for all the conceptual designs.

Table 1 Conceptual Designs of Suspension System

No	Conceptual Designs	Justifications
1		<ol style="list-style-type: none"> 1. Leaf spring is easy to maintain. 2. Leaf spring can absorb additional load through compression. 3. MacPherson strut is low cost and complexity and provides more compactness.
2		<ol style="list-style-type: none"> 1. Each of wheel moves up and down independently. 2. Swing half-axle can drive in high speed on rough roads. 3. Swing half-axle can pass over obstacles quickly. 4. Swing half-axle can resist against extreme impacts.
3		<ol style="list-style-type: none"> 1. MacPherson strut is designed with simplicity and take less space horizontally. 2. Macpherson strut is low cost. 3. MacPherson strut is easy to do the maintenance

3.0 RESULTS AND DISCUSSION

Based on the conceptual designs, Pugh method was used as the selection approach. Nine evaluation criteria were specified with their own weightage values. Higher weightage value was assigned to the criteria that were considered as more important. Then, score was given for each criteria for all the 3 conceptual designs.

Conceptual design with the highest score was going to be chosen for the detailed design. For the purpose of this study, cost was considered as the main criteria. The tabulated data is shown in Figure 2 below.

Table 2 Pugh Method of 6x6 Vehicle Concept Design

Evaluation Criteria	Weight	Reference Design	Concept					
			1		2		3	
Costing	20	0	S	0	-	-20	+	20
Space	15	0	-	-15	S	0	+	15
Safety	15	0	S	0	S	0	S	0
Simpler	15	0	S	0	+	15	+	15
Driving Stability	10	0	-	-10	S	0	+	10
Support More Load	10	0	+	10	+	10	+	10
Ride Comfort	5	0	-	-5	S	0	-	-5
Maintainability	5	0	S	0	+	5	-	-5
Good Handling	5	0	-	-5	S	0	-	-5
<i>TOTAL</i>	<i>100</i>	<i>0</i>		<i>-25</i>		<i>10</i>		<i>55</i>

The results show that conceptual design 3 obtains the highest score. Because of that, this concept is chosen as the suspension system configuration for the new 6x6 oil palm fruit bunch transporter vehicle. This design consists of MacPherson strut for all the 3 axles. Detailed design process is proceeded based on this selected conceptual design.

4.0 SUMMARY

The aim of this study is to select the best conceptual design of suspension 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 were based on the suspension system that were attached to 3 axles. 3 types of designs were produced, which used different types of suspension configuration. Then, the best design was chosen by using Pugh method. Evaluation criteria were listed and weightage of importance was assigned for every criterion. Based on the results, conceptual design 3 that achieved the highest score was chosen as the best conceptual design. This design used MacPherson strut suspension for all 3 axles.

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