



EIMARace (Steering, Differential, Brake, Bodywork)

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Abstract

EIMA RACE 2016 is a project undertaken aims to produce a race car specifically for the EIMARace competition. The racing car will represent Polytechnic Port Dickson in the competition which was held at Kompleks SUKPA, Pahang. The EIMARace involved modified four-stroke engine vehicles of the 131cc and 250cc variants. The objective of the project is to construct a car that follows the specifications, rules and regulations in the EIMARace competition. The main focuses in the construction of the car are the bodywork, steering system, differential system and brake system. The car will participate in the 131cc category by using an engine from Honda Wave 125. During our observation from the previous car in the EIMARace 2015, we noticed some systems should be upgraded. The steering system from the previous car used a rack and pinion system which causes a bad response from the driver during cornering and handling. So, the steering have been changed to go-kart steering system while improve the steering ratio. The differential from previous car has lack of ability to adjust the tension of the chain because it was connected by direct welding. The differential of this car was improved by having an adjuster connected to the differential housing where it can be adjusted so the tension of the chain can be set at the correct freeplay. The car is using four disc brake systems with a master pump. The bodywork also was improved by using fibreglass instead of using canvas from the previous car. All the systems have functioning well during the race. Although the EIMARace 2016 in SUKPA Pahang had been cancelled by the organizer due to a fatal accident, the car performs well during the free practice lap, timed practice lap and qualifying lap. The car able to finish 4 laps before the race stops and achieved the position 25 from 40 cars. The best lap time was 2 minutes 08 second where the average speed is 66km/h.

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Key-word: - eimarace, automotive, steering, bodywork, differential

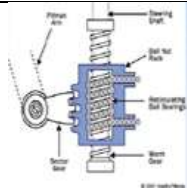
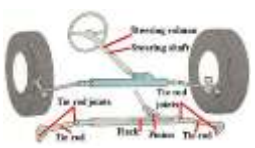




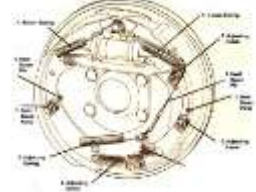




1. Introduction

“Educational Innovation of Motorsports and Automotive Race” (EIMARace) is a car racing competition that involved student from higher institutions around of Malaysia. This competition is usually held once a year and for this year, it was held at Kompleks Indera Mahkota, Kuantan, Pahang on 23 September until 25 September. Among the institutions that participated in this competition are Universities Teknologi Malaysia, Polytechnic Sultan Azlan Shah, Polytechnic Kota Bharu and Polytechnic Port Dickson. The categories offered in this competition are 250cc, 131cc (open), and 131cc (Endurance). Polytechnic Port Dickson team named ‘Ostrich Racing Team’ (ORC Team) consists of 12 automotive students from Mechanical Engineering Department were sent to represent PPD to participate in the competition. This group have studied and analysed the previous Eimarace 2015 car to improve the systems and fabricate a new racing car to replace the old one and will be participate in 131cc (open) categories. There are two groups of student which have carried out the different tasks and systems. Student from group 3 have focused on a differential system, braking system, bodywork and steering system whereas the group 4 focused on a suspension system, chassis, wiring system and an engine. The problems of this project are based on the problems faced during the previous Eimarace car. The first problem is a differential system. The differential system is not functioning effectively because the selection of a bearing are not suitable and the rear sprocket cannot accommodate the load of the engine and the car’s weight. The second problem is a brake system is not good enough because the selection of brake pad was not suitable so the brake system did not provide a good grip to stop the vehicle. The third problem is bodywork and finishing which the material selection of bodywork for the old car was not suitable and strong. The finishing process also was not complete and has a low

quality. The fourth problem is a steering system which is very important in handling aspect. The problem is the old steering system was using a rack and pinion steering system. So, the driver has to turn the steering wheel 2 times to make a U-turn and takes some times during the race. During the race, everything should be in quick response. Objective of this project is to design and to fabricate a racing car that can be used for EIMARace 2016 competition.

2. Methodology

Table 1 The selection of the system

	Idea 1	Idea 2	Idea 3
Steering			
	Recirculating Ball Steering	Rack and Pinion Steering	Ackerman Steering
Differential			
	Sprocket 44 : Gear Ratio 2.75	Sprocket 46 : Gear Ratio 2.88	Sprocket 48 : Gear Ratio 3.00
Brake			
	Drum Brake	Disk Brake	
Bodywork			
	Fiber Glass	Zinc	Cardboard

We prefer Ackerman steering system which widely used on wheeled light vehicles like Go-Kart for helping solve problems rotation of angle towards the inner and outer steering. For differential system, we use 48t sprocket to ensure the vehicle and engine load could be supported perfectly. The Gear Ratio is 3.00 which mean the acceleration of vehicle is high but the top speed of vehicle is quite slower. We suggest using a disk brake than drum brakes and power brake because the disk brake provides better traction and the brake will be more efficient. We use fiberglass as bodywork because fiberglass has a better finishing and higher resistance compared with zinc and cardboard.

3. Result and Analysis

Brake Test

Table 2 The data from brake test

Description	Record
Distance For Acceleration	100 metre
Distance To Braking	3 metre
Car Stopping Distance	1.25 metre
Average Of Speed	50 km/h

Based on the result above, the braking system are functional well because the car stopped at the designated distance. This car achieved a position of 25th from 40th participate before the race stopped at lap 6. The time record for this car on the race is 2 minutes 8 seconds on average and this car achieved an average top speed of 66 km/h.

Steering Ratio Calculation

Wheel track: 138 cm

Radius: $(165 \div 2) = 82.5$ cm

Turning radius: $82.5 \div 138 = 0.5978$ cm

Steering Ratio

R outer : $43^\circ \div 23^\circ = 1.869$

R inner : $20^\circ \div 23^\circ = 0.869$

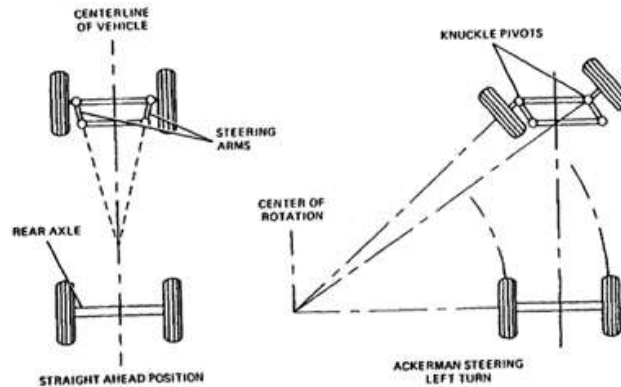


Figure 1 The Ackermann steering angle



Figure 2 The steering system for the car



Figure 3 The differential system



Figure 4 The bodywork of the car

4. Conclusion

Educational Innovation of Motorsports & Automotive Race 2016 (EIMARace 2016) is an Inter – Institutional open to private institution of higher Polytechnic Colleges and Technical Institutes conscious learning concept in motorsports. It is a platform for us to apply the theoretical and practical lesson learned in Polytechnic Port Dickson, thus we have improved the car from the previous version to the better one. We have successfully designed and fabricated a new racing car for EIMARace 2016. The steering system, differential system, brake system and bodywork system have work and functional well during the race. So, our objective of this project is successfully achieved.

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