



## **COMPARISON OF TWO SEATS DESIGN IN TERMS OF POSTURAL DISCOMFORT AND PRESSURE DISTRIBUTION**

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By

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Tajuk: **COMPARISON OF TWO SEATS DESIGN IN TERMS OF POSTURAL DISCOMFORT AND PRESSURE DISTRIBUTION**

Sesi Pengajian: **2018/2019 Semester 2**

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Date : 26 June 2019

## **APPROVAL**

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Hons.)

The members of the supervisory committee are as follow:

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Associate Professor Dr Seri Rahayu Kamat

## ABSTRAK

Industri Automobil memainkan peranan penting dalam memastikan pembangunan Malaysia berkembang dengan teknologinya. Keselamatan akan menjadi kebimbangan mereka ketika membuat kereta. Semasa mengeluarkan kereta, komponen luaran dan dalaman kereta mestilah mengikut piawaian dan prosedur yang ditetapkan. Komponen yang paling penting dalam kereta akan menjadi tempat duduk. Pemandu cenderung berasa lemah dan mudah letih ketika memandu. Akibatnya, pemandu akan mudah terlibat dalam kemalangan yang tidak dijangka. Oleh itu, matlamat kajian ini adalah untuk mengkaji tahap keletihan dan pengagihan tekanan kerusi mengikut faktor fisiologi dan biomekanik. Untuk menganalisis faktor fisiologi, satu kaji selidik dalam talian telah dijalankan dan mengesahkan hasilnya dengan Perisian Minitab Sementara itu, untuk mengkaji faktor biomekanik, dua kaedah akan digunakan di mana kaedah pertama, eksperimen dengan menggunakan simulator pemandu akan digunakan untuk menganalisis kerusi pengagihan tekanan untuk 15 responden. Untuk kaedah kedua, satu kaji selidik akan dijalankan kepada 15 responden mengenai tahap penyelesaian selepas eksperimen. Seterusnya, untuk menentukan kekerasan busa kerusi, ujian mampatan akan dilakukan pada sampel beberapa busa kerusi. Berdasarkan keputusan yang diperoleh, Perodua Bezza mempunyai pengedaran tekanan tertinggi untuk *Backrest* di mana Proton Saga mempunyai pengedaran tekanan maksimum untuk tempat duduk kusyen.

## **ABSTRACT**

Automobile Industry plays an important role in ensuring Malaysia's development is thriving with its technology. Safety will be their very first concern while manufacturing a car. While manufacturing a car, the external and internal components of the cars should be in accordance with the standards and procedure specified. The most important components of a car will be the seat. Drivers tends to feel weak and easily tired when driving away. As the result, the driver will be easily involved in unexpected accidents. Therefore, the aim of this study is to investigate the postural discomfort and seat pressure distribution for both Proton Saga and Perodua Bazza. To analyze the postural discomfort, an online survey have been conducted and validated the result with Minitab Software Meanwhile, to investigate the pressure distribution, two methods will be used whereby the first method, an experimental by using driver simulator to analyze the seat pressure distribution for 18 respondents. For the second method, a survey will be conducted to the 18 respondents about the comfort level after the experiments. Next, in order to determine the hardness of the foam, a compression test will be done on a sample of few foams. Based on the result obtained, Perodua Bezza having the highest pressure distribution for Backrest whereby Proton Saga having the maximum pressure distribution for the cushion seat.

## **DEDICATION**

For my beloved parents:

Mr. Mohd Yusoff Bin M.K. Mohd Mydin

Mrs. Najiya Binti Anwar Ali

To my beautiful sisters:

Nurhanna Binti Mohd Yusoff

Nur Farhana Binti Mohd Yusoff

To my supportive Supervisors and friends:

Associate Professor Dr. Seri Rahayu Kamat

Dr. Syamimi Binti Shamsuddin

Ms. Sharifah Nadya Binti Syed Azmi

Mohammad Firdaus Ani

Nur Alya Syaherah Binti Mohd Hassan



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## LIST OF ABBREVIATIONS

PROTON	-	Perusahaan Otomobil Nasional Berhad
SUV	-	Sport Utility Vehicle
Perodua	-	Perusahaan Otomobil Kedua Sendirian Berhad
EMG	-	Electromyography
ESC	-	Electronic Stability Control
LDW	-	Lane Departure Warning
IRF	-	Injury Risk Factor
ATP	-	Adenosine triphosphate
BMI	-	Body Mass Index

# CHAPTER 1

## INTRODUCTION

Chapter one introduces the background of study which will investigate to an ergonomics problems occurs in an automotive industry. On top of that, this chapter also comprises 7 sub-title which are the background of study, problem statement, objective of study, scopes of study, significant of study, organization of report and summary of chapter one.

### 1.1 Background of study

Automotive industry have been established in Malaysia since 7 May 1983 which knows as Perusahaan Otomobil Nasional Berhad (PROTON). This company manufactures 8 models of car which are Proton Ertiga, Saga, Pesona, Perdana, Iriz, Suprima S, Preve and Exora. Currently, PROTON introduced its vey first Sport Utility Vehicle (SUV) model known as PROTON X70 collaborating with new partner Zhejiang Geely Holding Group. Thousands of car have been manufactured and being exported to the other countries such as Indonesia, Singapore, Thailand and the latest one to the Middle East. There are also second National car in Malaysia known as Perusahaan Otomobil Kedua Sendirian Berhad (Perodua) founded in 1993 with currently producing four models which are Perodua Axia, Perodua Myvi, Perodua Alza and Perodua Bezza. Perodua also will release their new model known as SUV. A websites shows a statistics of sales performance for Proton Saga in 2017 recorded about 70,991 units sold and Perodua Bezza (Lye & Gerrad, 2018) and Perodua Bezza sales performance with nearly 100,00 of units sold for during first half of 2017 (Tan, 14).

Despite all the model, safety has become their main concern while manufacturing the cars. When it comes to safety, absolutely it will be related to its driver, passenger and people out there. Therefore, this thesis will analyze the postural discomfort known as psychological and pressure distribution referred to as biomechanical for our National car of Proton Saga and Perodua Bezza.

Psychological is linked to a person's mental and emotional state. There are several methods to investigate the psychological factors such as collecting the anthropometric data, Electromyography (EMG) or user trials and observations. EMG can be used to measure the muscle response to a nerve's stimulation of the muscles which help to detect the neuromuscular abnormalities. For example, the fatigue and comfort level of the person. Next, Biomechanical Factors can be defined as the dimension, composition and mass properties of body segments, joints linking the body, muscles that produce body movements, mobility of joints, mechanical reactions of the body to force fields and voluntary body movements in applying forces to external objects (Bhise & Vivek D., 2012)

Every seat in a car is designed as per regulation. The difference will be the scientific knowledge supporting the design of a comfortable car seat is scarcely available and the effect of new features such as massage systems, neck rests, ultra-light seats, lumbar supports and the form of the seat are unknown (M. Manfred, 2010). Some of the buyers might consider these factors during purchasing a car (Zenk & Raphael, 2008). Each driver has their own style or posture of seating whether seated comfortably, seated more to the right side or left side. This posture will lead to a pressure distribution reading. Seat pressure distribution is known as the interface between the human body and the surface of the seat. For example, there is a person seated on the car seat and feels pressured under its lower part of their body such as the hip. From there, if the person feels uncomfortable such as easy to feel pain at the lower part of the body and tired during their driving either nearby or long journey, it will affect the driver's fatigue and tend to be involved in accidents because of the physiological and biomechanical factors.

## 1.2 Problem Statement

It is impossible to get zero number of accident but, as a user they can reduce the numbers of accident whether it is involved cars, motorcycles or even busses and lorries. Studies shows that there are increasing on the number of road crashes and road deaths from 2008 to 2017 (MIROS, 2018). Table 1.1 shows the statistic of road accidents in Malaysia from 2008 to 2017.

Table 1.1: Statistic by MIROS (MIROS, 2018)

NEGERI State	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PERLIS	1,417	1,633	1,548	1,791	1,881	1,895	1,888	1,861	2,062	1,925
KEDAH	16,520	17,701	17,966	19,699	19,935	20,228	20,159	22,016	23,200	23,262
PULAU PINANG	34,049	33,719	34,306	37,158	37,851	39,361	38,747	39,856	42,244	43,007
PERAK	30,539	32,327	32,072	33,506	34,714	35,408	35,131	36,736	38,531	38,587
SELANGOR	100,380	107,429	115,565	128,876	129,106	135,024	137,809	140,957	151,253	154,958
W.P. KUALA LUMPUR	48,671	51,942	53,493	58,795	61,872	64,527	63,535	64,664	68,866	72,940
NEGERI SEMBILAN	17,362	18,369	19,407	21,157	22,146	23,066	23,748	22,939	24,428	24,941
MELAKA	12,105	13,275	14,110	14,720	15,195	16,083	16,375	17,069	18,601	18,771
JOHOR	48,667	51,747	55,381	59,501	62,316	64,600	64,473	67,112	73,116	76,121
PAHANG	15,629	17,068	17,315	19,001	20,554	20,130	19,071	19,635	20,465	20,813
KELANTAN	8,842	9,549	9,707	9,603	9,968	9,748	10,326	9,960	10,544	10,786
TERENGGANU	8,814	10,118	10,106	10,684	10,861	10,996	9,383	10,381	10,793	10,713
SABAH	14,588	15,798	16,192	16,585	17,446	17,438	17,858	17,290	17,298	17,244
SARAWAK	15,488	16,655	17,253	17,964	18,578	18,700	17,693	19,130	20,065	19,807
JUMLAH Total	373,071	397,330	414,421	449,040	462,423	477,204	476,196	489,606	521,466	533,875

There are several causes of accidents from the statistic above that might happened during driving such as feeling uncomfortable or back pain for long journey, tired, sleepy or recklessly or ignoring traffic rules. According to World Health Organization, Malaysia has been ranked as one of the top three countries in the world deadliest roads (Ruxyn, 2017). On the other hand, there were study shows that there was a significant relationship between emotion, personality traits, role-modeling and driver's attitude towards safety (YII & Julia Lau Siew, 2015). There were also a study shows about the important of seat in vehicle especially for driver's seat. The influence of different forces and vibrations transmitted to the human body through body through the car seat during the drive shows a distinctive importance because they inflict a state of tiredness, especially to the driver who makes an additional effort in comparison the other passenger (R. Miklos *et al*, 2013).

In this study, a pilot study have been done whereby a survey for 40 respondents have been distributed in order to measure the comfort level. Figure 1.1 shows the data prove that the comfort factors while driving is poor body posture.

17. Which factor/s did you feel give discomfort to your body while driving?

38 responses

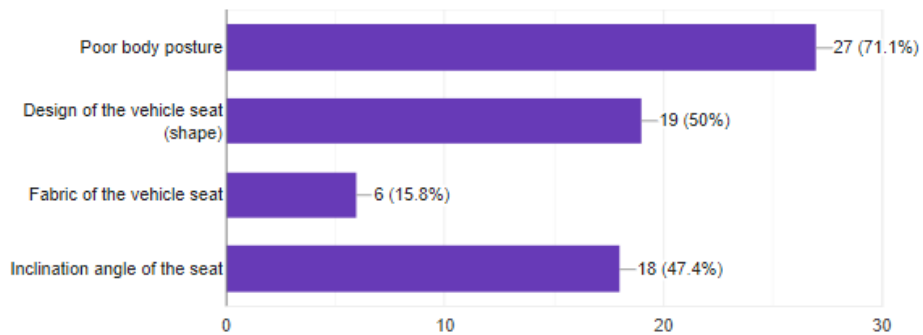


Figure 1.1: Factors of discomfort while driving

Based on the result out of four factors, poor body postures are the most discomfort factor been faced by 27 respondents (71.1%) while driving. Next, design of the vehicle seat contributed about 19 respondents (50%) and inclination angle of the seat have 18 numbers of respondents (47.4%) that discomfort with it while driving. Last but not least, the forth factors which is the fabric of the vehicle seat contributed about 15.8% which was 6 respondents.



Figure 1.2: World Health Organization (Ruxyn & Tang, 2017)

Figure 1.2 from (Ruxyn & Tang, 2017) shows, Malaysia registered a death rate of about 23 per 100,000 population. It is reported that about 7,000 to 8,000 people in the country died on the roads every year with population of 30 million Malaysians. Besides, a total of 80.6% of the road accidents are caused by human error (Ruxyn & Tang, 2017). According to the AAA Foundation for Traffic Safety estimates that 21% of fatal motor vehicle crashes involve driver fatigue (Tefft *et al.*, 2014). From the statistic shown, it is important to understand about drive fatigue because it is involved during driving a car. In this study, drive fatigue lead to the involving of two components which are physiological factors and biomechanical factors for seat pressure distribution. The pressure distribution of the seat is important to be analyze because it is one of the method of sitting for long periods.

With above factors and considerations, a study about the postural discomfort and pressure distribution will be done.

### **1.3 Objectives of Study**

The objectives to Comparison of Two Seats Design in terms of Postural Discomfort and Pressure Distribution are:

1. To determine the psychological feedback of driver using postural discomfort experienced driver while using the two seats (Proton Saga and Perodua Bezza).
2. To analyse the movement and pressure distribution at driver seat.
3. To compare the hardness and biomechanical factors between two seats (Proton Saga and Perodua Bezza).

## **1.4 Scope of Study**

The scope area of this study will be the two car seats which are Proton Saga and Perodua Bezza. Those models been chosen because it is from the same segment which is segment-A with the size of the wheelbase for Proton Saga is 2465mm while Perodua Bezza is 2455mm. Throughout this project, the focuses will be on the factors of psychological and biomechanical for both of the seat. An online survey will be distributed for 40 respondents.

The limitation of the study is only involved for the 5<sup>th</sup>, 50<sup>th</sup> and 95<sup>th</sup> percentiles because to gain the maximum value for each of the consideration of postural discomfort and pressure distribution. The findings of the study are based on the survey and experiment. The implementation of the study based on the three findings above (percentiles).

## **1.5 Significant of study**

This study is significantly providing several potential benefits to the following parties. The specific benefits of participatory ergonomics are:

1. Automotive Industry

The findings will give a standard value for seat pressure distribution as a new knowledge of standardizing pressure distribution.

2. Society

The psychological and biomechanical factors can determine the postural discomfort and pressure distribution of the driver.

3. Environment

The findings will help to reduce the numbers of accident on roads due to discomfort reason.