

DESIGN AND MODIFICATION FOR CHILD RESTRAINT SEAT ON  
MOPED MOTORCYCLE

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A thesis submitted in fulfillment of the  
requirements for the award of the degree of  
Engineering Technology

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## DECLARATION

I declare that this thesis entitled “Design and fabricate a child restraint system for underbone motorcycle” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....  
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Date : .....

To my beloved father and mother

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## **APPROVAL**

This report is submitted to faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Product Design). The member of supervisory is as follows:

.....  
(Project Supervisor: HAIRUL EFFENDY AB MAULOD)

## **ABSTRACT**

Moped motorcycles are common in developing countries such as Malaysia. It is one of the most popular mode of transportation for lower income group. It is therefore common to see the safety consideration especially towards the pillion rider is not considered a priority. A conventional child seat restraint was acquired and its design requirements was taken into account for placement on a moped motorcycle. A child seat restraint for a conventional moped is almost non-existent and therefore modifications were needed for its suitability. The child restraint seat was simulated and analysed using a CAD software. Market survey and also product design criteria were also taken into consideration. The weight and positioning of a child pillion rider was also taken into account to increase effectiveness and safety of the child. Based on the study minimal modification was found necessary in order to safely secure the child seat restraint on a moped motorcycle. Finally the child seat restraint was placed and secured on the moped motorcycle according to the design. A full drawing of the modification and also child seat restraint design were produced to fulfill design requirements.

## **ABSTRAK**

Motosikal adalah pengangkutan utama di negara membangun seperti Malaysia. Ia adalah mod pengangkutan yang popular dikalangan kumpulan pendapatan yang rendah. Oleh itu, tidak hairan aspek keselamatan terhadap pembonceng motorsikal tidak dianggap suatu keutamaan. Satu tempat duduk keselamatan kanak-kanak telah diperolehi dan keperluan rekabentuk telah diambilkira untuk diletakkan di atas sebuah motorsikal. Tempat duduk keselamatan kanak-kanak hampir tidak ditemui untuk motorsikal jenis kuasa rendah atau kapcai. Tempat duduk keselamatan kanak-kanak telah disimulasi dan dianalisa menggunakan perisian CAD. Tinjauan pasaran dan juga keperluan rekabentuk juga telah diambilkira. Berat dan kedudukan penunggang kanak-kanak juga diambilkira untuk meningkatkan keberkesanan dan keselamatan penunggang kanak-kanak. Berdasarkan kajian didapati modifikasi yang minima diperlukan supaya tempat duduk keselamatan kanak-kanak dapat dipasang dengan selamat pada motorsikal. Akhir sekali, tempat duduk keselamatan kanak-kanak telah diletakkan di atas motorsikal mengikut keperluan rekabentuk. Lukisan penuh modifikasi dan jugak tempat duduk keselamatan kanak-kanak telah dihasilkan untuk memuhi keperluan rekabentuk.

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## **LIST OF ABBREVIATIONS, SYMBOL AND NOMENCLATURE**

in	-	Inches
CAD	-	Computer Aided Design
SLD	-	System Level Design
CG	-	Centre of Gravity
AAP	-	American Academy of Pediatrics
V6	-	Version 6
UAS	-	Universal Anchorage System
NCHS	-	National Centre for Health Statistics

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

In developing countries including Malaysia, motorcycles are cheap and affordable mode of transportation. It is not common to see, the motorcycles being used for almost all daily activities. For lower income groups a motorcycle could be considered a lifeline and important tool for daily life. Sadly though this also one of the attributes that safety of riding and pillion rider does not take utmost precedent. (Sivasankar, K. Karmegam, M.T. Shamsul Bahri, H. Sadeghi Naeini, & S. Kulanthayan, 2014).

### 1.1 Project Background

Motorcycle related accidents often prove fatal due to its safety risk nature. Legislation in Malaysia regarding safety are currently based on “supply and demand” system. Accidents involving motorcycles reflects an alarming need for attention. Pillion rider are the most risk when compared to the rider due to the nature of their seating and often are not equipped when faced with risk of accident.



## **1.2 Problem Statement**

Children when riding requires special attention since their anatomy are different than adult. Often in motorcycle-related accidents, children usually sustain lower limb injuries, which could temporarily or permanently inhibit the child's movements. Furthermore often during the ride, children are easily tired and could doze off. Special requirements are needed to ensure their safety and comfort during pillion riding.

## **1.3 Objectives**

The objective of the project is to;

- a) To study the existing child seat restraint.
- b) To design modification of child seat restraint to suit moped motorcycle placement.
- c) To attach the modified child seat restraint on a moped motorcycle.

## **1.4 Project Scope**

The project scope of the project is for the;

- Study current system of underbone motorcycle carry a child.
- Adapt current system for underbone motorcycle.
- Determine an economical and suitable system for moped motorcycle to pillion riding a child.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.0 Introduction

This chapter will discuss mainly on the theory and current development in moped (underbone) motorcycle and child restraint system in transportation. This chapter will shows about the studied, product and the current research that had been found in developing child restraint system in transportation.

#### 2.1 Moped Motorcycle



**Figure 0.1: The new model Honda C50 moped**

Moped motorcycles or mopeds were first developed as motorized bicycles after the end of the First World War. It was earlier just known as motorized bicycles until better development such as improved transmissions and better engine performance made the term “moped” or motor pedal being coined.



**Figure 2.2: Variety of moped motorcycle**

Based on the figure, there are variety of moped motorcycle that were currently in market. Some of it are being manufactured to Malaysia. The moped motorcycle are been used in Malaysia due to their affordable price and ease of use. More often we can see a young or child pillion rider clinging on to an adult at the front of the motorcycle in Malaysia. By the study, the main issues facing for the young pillion riders is that their safety is often not taken into account when they are riding on a motorcycle (Sivasankar, K. Karmegam, M.T. Shamsul Bahri, H. Sadeghi Naeini, & S. Kulanthayan, 2014).

From this statement, this project is about to designing child safety for moped motorcycles. This project is expected to improve the safety of pillion riding for small children since they are easily fatigued.

## 2.2 Restraint System

The restraint system is about the ergonomic features that had in the car seat for child is to supports the occupant's body under all driving conditions, offers adequate protection and body support in the event of an accident, allows for extended sitting without fatigue by relieving stress on the body's muscular system, provides a contour matched to the vehicle and the occupant (sports seat, comfort seat) without restricting movement and we can also founded that back pain is the most common reason for visiting the doctor, accounting for almost 50 million sick days annually in Germany. Those most affected are people engaged in repetitive physical activities, especially frequent drivers (Pediatrics, 1998).

In addition, driving for hours in a forced posture without any compensatory movement is harmful to the back. Ergonomically incorrect sitting postures (such as "swayback") further exacerbate the negative effects. This quickly leads to abrasion of the spinal disc and to back problems.

From my study, it is stated that from the American Academy of Pediatrics (AAP) were recommends that children 2 years or older, or those younger than 2 who have outgrown the weight or height limits for their rear-facing safety seat. It also state that this situation can be restrained in the back seat of the car in a forward facing safety seat with a harness for as long as possible, up to the highest weight or height allowed by the manufacturer of the safety seat. We will need a new safety seat if we have been using an infant only child safety seat. We can still use the safety seat but will need to make a few adjustments to the shoulder straps, and reroute the vehicle seat belt or latch properly for it to be used forward facing that have been using a convertible child safety seat in the rear facing position. We must make sure to read our child's safety seat manual to learn what changes need to be made when switching the seat from rear facing to forward facing.

## **2.3 Types of Child Safety Seats**

### **2.3.1 Convertible Safety Seat**

The convertible child safety seat can be used in both the rear facing and forward facing positions. This type of seats must remain rear facing until our child is 2 years old or until he reaches the highest weight or height allowed by the manufacturer of his convertible safety seat (Guo SS, 1996). In this study, the idea must be modified to create the product that is suitable for child to seat at the motorcycle. Based on the convertible safety seat, the design of this product is related for the use of the average child at the age of 2 until 6 years old that is suitable for most child that been carried using the underbone motorcycle.

In addition, we can switch a convertible safety seat from the rear facing to the forward facing position, it can be used for a toddler up to 40 to 65 pounds (some seats accommodate up to 80 pounds) depending on the seat model (Guo SS, 1996)

### **2.3.2 Types of Child Safety Seats**

There are three types of child safety seats for babies:

- Infant only Child Safety Seats
- Rear facing Convertible Child Safety Seats
- Car Beds

### 2.3.3 Infant-only Child Safety Seats

Infant-only safety seats are unique in that they are usually rear facing and come with a three or a five point harness. The most common type of harness is a five point, with two straps that secure the shoulders and two more that secure the hips. The straps all connect to a buckle between the legs. A less common type is a three point harness, which functions the same way but lacks the points at the hips.

Portable with a carrying handle; they can be easily removed and used as infant carriers. For most infant seats, the carrying handle should be down when our child is in the vehicle. Be sure to check our safety seat instruction manual for proper placement of the carrier's handle during travel.

## 2.4 Rear-Facing Convertible Child Safety Seats

A convertible child safety seat can be used in both the rear-facing and forward-facing positions. Convertible child safety seats must be used in the rear-facing position in the back seat of the car until your child is 2 years of age or until he reaches the highest weight or height limit allowed by the manufacturer of his convertible safety seat. The seat can then be turned around to face forward for toddlers.



**Figure 2.3: Example of rear facing**

A rear facing safety seat is the restraint system to support the child range of birth of 0 to 16 kg (Birth to 35 lb.) A rear facing child safety seat is used correctly if it is facing the rear of the vehicle. The rear facing seat is type of vehicle seat belt or Universal Anchorage System (UAS). This type of seat is not used in a position where there is a passenger front-seat air bag. The locking clip at the safety belt of the rear facing seat must be used correctly when required. When using the rear facing safety seat, we must also make sure that the chest clip is level with the child's armpits.

The internal harness of the rear facing is used according to the manufacturer's instructions. The internal harness should be even or slightly below the height of the child's shoulder. Internal harness is snug. One of our fingers should fit between the child's collar bone and internal harness.

## 2.5 Forward Facing Child Safety Seats



**Figure 2.4: Example of forward facing**

A forward facing safety seat is the restraint system to support the child range of birth of 10 kg to 18 kg (22 lb. to 40 lb). A forward facing child safety seat is used correctly if it is facing forward and in the upright position. The forward facing safety seat are also the vehicle seat belt or UAS is routed correctly through the proper guides in the back of the child safety seat. Same as the rear facing safety seat, the forward facing safety seat locking clip are also must be is used correctly when required. In addition of the forward facing safety seat type, the tether strap is hooked

to the proper tether anchor located in the vehicle. Same as the rear facing safety seat, the chest clip is level with the child's armpits.

As the rear facing safety seat, the internal harness of forward facing are also is used according to the manufacturer's instructions. The internal harness should be even too slightly above the child's shoulder. Internal harness is snug. One of our fingers should fit between the child's collar bone and internal harness. We must also make sure that the internal harness should be routed according to the manufacturer's instructions.

## **2.6 Car Beds**

Some convertible child safety seats may not provide the best fit for smaller newborns, especially low-birth weight babies or preterm babies (those born too early). For these smaller children, car beds are a safer alternative to standard car seats.

## **2.7 Combination Child Seat and Belt-Positioning Booster Seat**

The combination child seat and belt-positioning booster seat is the combination seat with the internal harness until our toddler weighs about 40 to 65 pounds, depending on the seat model. We can then remove the harness and convert the seat to a belt-positioning booster that works with the vehicle lap and shoulder belts. For the best protection, use a child safety seat with a full harness until our child has outgrown the weight and height limits before switching to a booster seat (Pediatrics, 1998).

The combination child seat and belt-positioning booster seat also best to low the risk of injuries for babies. This is because the babies are at greater risk of injury in crashes. This study also shows that babies spines are developing and their heads are large for their bodies. In a crash, if our child is riding forward facing, her spinal cord may stretch, which could result in serious injury or death. However, when our