

DEVELOPMENT OF ERGONOMICS PASSENGER CAR DRIVER SEAT
CONCEPT DESIGN

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This technical report is submitted in accordance with the requirements of the
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CONFIRMATION

“I admit that have read this work and in my opinion this work was adequate from scope aspect and quality to award in purpose Bachelor of Mechanical Engineering (Automotive)”

Signature :.....

1st Supervisor's name:.....

Date :.....

Signature :.....

2nd Supervisor's name:.....

Date :.....

DECLARATION

“I hereby, declare this thesis entitled
Development of Ergonomics Passenger Car Driver Seat Concept Design
is the results of my own research except as cited in the reference”

Signature :
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Date : 9 APRIL 2009

To My Beloved Mother,
Pn Hajah Noraini Mansor

and My Beloved Father.
Tn Haji Mat Samuji Sakidi

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ABSTRAK

Objektif projek ini adalah bagi membangunkan reka bentuk konseptual satu kerusi pemandu yang ergonomik bagi kegunaan kereta penumpang. Beberapa kaedah-kaedah telah digunakan termasuklah kajian ilmiah, kajian teori-teori yang berkaitan, pengumpulan maklumat ukuran antropometrik data bagi populasi Asia dan juga mengadakan soal selidik sebagai kaedah mengumpul data. Daripada maklumat yang telah dikumpul, beberapa rekabentuk konsep boleh dibangunkan dan rekabentuk konsep yang terbaik akan dipilih. Rekabentuk konsep yang telah dipilih akan dipindahkan kepada data pemodelan pejal dengan menggunakan perisian CATIA. Aplikasi “ergonomics design and analysis” dalam perisian CATIA digunakan menyahihkan aspek ergonomik reka bentuk tersebut menggunakan analisis RULA dan pengesahan dengan menggunakan “mannequin” pada perisian itu berdasarkan persentil ke-50 orang dewasa Asia untuk mensimulasi secara visual jarak penglihatan “mannequin” tersebut dengan melakukan dua kajian kes menggunakan data kenderaan sebenar.

ABSTRACT

The objective of this project is to develop the conceptual design of an ergonomics driver seat for passenger car. Several methods has been applied which are literature on previous research, study of related theories, gathering information on Asian anthropometric data and also set up questionnaire as data collection method. From the gathered information, several concept designs can be developed and the best will be selected. The final concept design is being transformed into solid modelling data by using CATIA software. Application of ergonomics design and analysis in CATIA software is being used to validate the ergonomics aspect of the design by using RULA analysis and validation by using mannequin application on the software based on 50th percentile of Asian adults to visually simulate the visibility of the mannequin by doing two case studies using real vehicle data.

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CHAPTER 1

INTRODUCTION

The basic feature in the urban life is the movement of large volume of people between residential area and places of work. People tends to possess their own car due to several factors such as it is available when required, the car takes the people from point A to point B besides ensuring the privacy and comfort. One of the problems that occur in driving is the bad design of the seat normally happened in budget car which results on less comfort to the driver.

1.1 OBJECTIVE OF THE PROJECT

- a) To come out with the ergonomics passenger car seat concept design in form of 3D solid modeling data.
- b) To understand the human characteristics and its ergonomics position during sitting in the passenger car.
- c) To do validation work of the ergonomics position.

1.2 SCOPE OF THE PROJECT

- a) Literature on
 - Related standards and requirements, including existing designs, and patents.
 - Human characteristics when sitting on the car seat in term of ergonomics and safety.

- b) Design
 - To established the engineering design specification for ergonomics car driver seat
 - To develops concept design base on finding.
 - To select the final concept design, followed by solid modeling data development using the CAD system.

- c) Analysis
 - To do evaluation and analysis of concept design that has been developed.
 - To do a validation work virtually in term of visibility
 - Conclusion and design recommendation (for further development).

1.3 PROBLEM BACKGROUND

In the meantime, the passenger car has unfortunately come out with the uncomfortable seat, resulted from bad design and shape. This problem normally can be found in the budget car. In this research, the concept design of the ergonomics passenger car seat will be developed based on the important data that is related to the ergonomics positions of human body when sitting in the car. The design will cater all

the ergonomics position and ensure all these positions to be put on the right place and right time.

1.4 EXPECTED RESULT

From this project, the result should be the concept design of an ergonomics driver car seat. The car seat should cater the entire angle that leads to ergonomics position of the human. The anthropometric data of 50th percentile of Asian adults is being referred. Validation work should be done in term of visibility and RULA analysis.

CHAPTER 2

LITERATURE REVIEW

The literature review is to state the previous research findings, the discussion on the related standards and requirements of the car seat including the existing design and understand the importance of the input data needed to be considered in the design process.

2.1 ERGONOMICS

Ergonomics is the scientific discipline concerned with designing according to the human needs, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance which is also called human engineering and human factors (Wikipedia a). When ergonomics factor is taken into account, the human capabilities and limitations of the certain design is being considered.

Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. The main causes of these injuries are quick, repetitive actions, awkward position, use of force, and lack of rest. Minimization of repetitive tasks and awkward body positions can help to prevent such injuries from occurring (Lawrence).

2.1.1 ERGONOMICS ASPECTS

There are five main points of ergonomics aspects. The aspects are safety, comfort, ease of use, productivity or performance, and aesthetics (Wikipedia a).

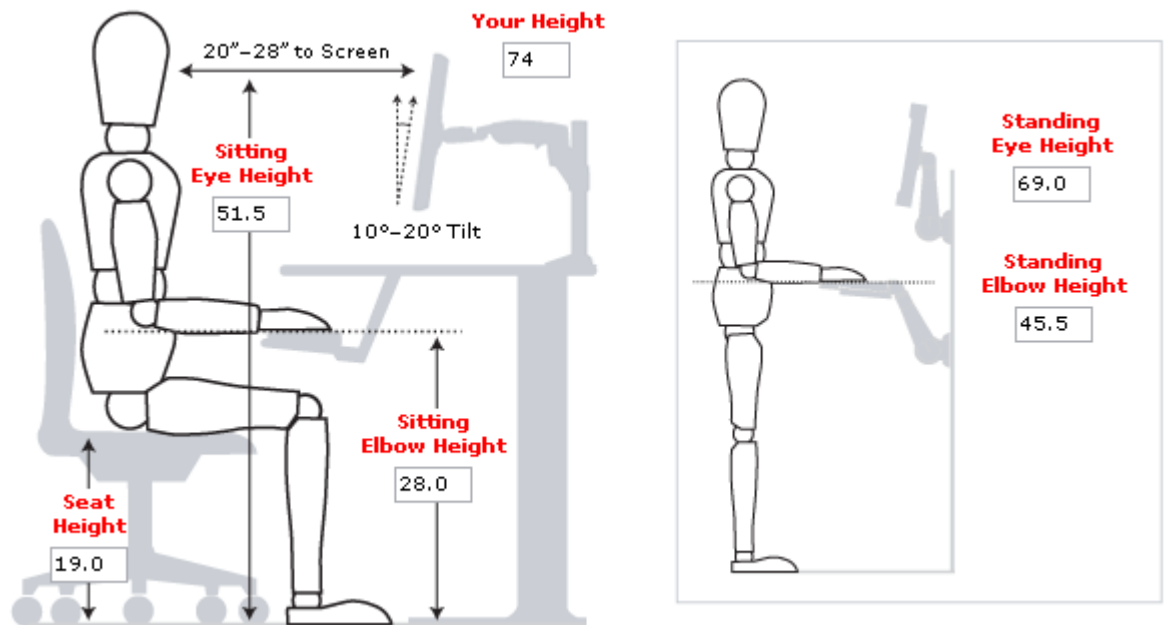


Figure 2.1: Ergonomics factor when designing workplace (McLeod, 2007)

2.1.2 HISTORY OF ERGONOMICS

Ergonomics has been considered since the culture of Ancient Greece. (Marmaras. N, 1999) The ergonomic terms is derived from the Greek words *ergon* [work] and *nomos* [natural laws] and first entered the modern lexicon when Wojciech Jastrzębowski used the word in his 1857 article *Rys ergonomji czyli nauki o pracy, opartej na prawdach poczerpniętych z Nauki Przyrody* (Wikipedia a) Wojciech Jastrzebowski created the word ergonomics in 1857 in a philosophical narrative, "based upon the truths drawn from the Science of Nature" (Ergoweb Inc).

World War II makes deep impact in greater interest of human-machine interaction as the efficiency of sophisticated military equipment for example an aeroplane could be compromised by bad or confusing design. Design concepts of

fitting the machine to the size of the soldier and logical/understandable control buttons evolved.

After World War II, the focus of concern expanded to include worker safety as well as productivity. Research began in a variety of areas such as (Ergoweb Inc):

- i. Muscle force required to perform manual tasks.
- ii. Compressive low back disk force when lifting.
- iii. Cardiovascular response when performing heavy labor.
- iv. Perceived maximum load that can be carried pushed or pulled.

In the early 1900's, the production of industry was still largely dependent on human power and ergonomic concepts were developing to improve worker productivity. Scientific Management which is a method that improved worker efficiency by improving the job process became popular.

Frederick W. Taylor was a pioneer of this approach and evaluated jobs to determine the "One Best Way" they could be performed. At Bethlehem Steel, Taylor dramatically increased worker production and wages in a shoveling task by matching the shovel with the type of material that was being moved (ashes, coal or ore) (Ergoweb Inc).

Frank and Lillian Gilbreth made jobs more efficient and less fatiguing through time motion analysis and standardizing tools, materials and the job process. By applying this approach, the number of motions in bricklaying was reduced from 18 to 4.5 allowing bricklayers to increase their pace of laying bricks from 120 to 350 bricks per hour (Ergoweb Inc).

2.2 CAR SEAT

The car seat purpose is to support the buttocks, the thighs, the back which include the upper and lower back and the head support. Three main parts that the existing car seat designs possess are the seat back (squab), the seat base (cushion) and the headrest (Bryan, 2008). Most of the car seat nowadays has all of these parts.

2.2.1 EVOLUTION OF CAR SEAT

Car seat design has been improved gradually. In the earlier days of car invention, the car seat is not as comfortable as it may have nowadays. The design is based on the adaptation of the horse-drawn carriage. The evolution of car seat started with bench seat in the earlier days to bucket seat in the present days.



Figure 2.2: 1885 Benz Motorwagen with bench seat (Logitech)

The figure above shows the Karl Benz 1885 Motorwagen that had a hard, wood bench seat that stretch from driver to passenger and a thin, curved beam that hit the upper back providing minimal support (Logitech). The main point of this seat is that it is fixed in only one position. Even though there are many alterations being made such as padded upholstery and additional substantial back support, the fixed position leads to many problems, as different people has different shape of lumbar.

Next, for the Ford Model T which is the first automobile built by mass production by Ford Britain during 1914 (Wikipedia b). The seat has not changed much. The car seat is the same fixed position with padded upholstery.

The changes of the car seat design happen tremendously after that year. The Ford Model A for the year 1930 seat had been revolutionized with added adjustability to the front seats with a ‘worm gear controller’ which is the metal rod that ran beneath the front seat to move the seat forward and rearward



Figure 2.3: Ford Model A 1930 (Wikipedia c)

In the 50's and 60's with the introduction of the sport and compact cars such as the Aston Martin DB2, the nowadays concept bucket seat has been made into mass production.



Figure 2.4: Aston Martin DB2 Coupé 1952 (Wikipedia d)