

TOTAL DESIGN OF MULTIPURPOSE TRAY
FOR KTM TRAIN SEAT

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SUPERVISOR DECLARATION

“I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Automotive).”

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FOR KTM TRAIN SEAT**

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**This report is submitted in partial
fulfillment of the requirements for the award of a
Bachelor of Mechanical Engineering (Automotive)**

**Faculty of Mechanical Engineering
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DECLARATION

“I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged.”

Signature:

Author:

Date:

Special thanks

My family

My Final Year Project supervisor

My seminar panels

My coursemates

My friends

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ABSTRAK

Malamat Projek Sarjana Muda (PSM) memberi tumpuan kepada merekabentuk dulang serba guna untuk Keretapi Tanah Melayu (KTM). Reka bentuk dulang serba guna mesti dapat berfungsi sebagai dulang makanan dan melaksanakan fungsi tambahan. Di peringkat awal projek, objektif, skop dan pernyataan masalah telah ditentukan. Objektif projek ini adalah untuk merekabentuk dulang serba guna untuk kerusi KTM. Pernyataan masalah adalah dulang makanan lama yang digunakan dalam kereta api KTM telah rosak dan tidak dapat berfungsi sebagai direkakan. Untuk menggantikan dulang makanan lama, reka bentuk dulang makanan baru dengan serba guna diperlukan. Proses reka bentuk dulang serba guna mengikuti proses reka bentuk keseluruhan. Satu sesi percambahan fikiran dijalankan untuk menjana idea-idea reka bentuk konsep. Selain itu, kajian penyelidikan telah dijalankan untuk mendapat maklumat tentang kehendak pelanggan dan pendapat mereka tentang bagaimana reka bentuk dulang makanan baru yang sepatutnya. Konsep reka bentuk yang dihasilkan berdasarkan input daripada kajian and sesi percambahan pemikiran akan dinilai oleh kaedah bernama *weighted objective method*. Pengiraan dan analisis CAE (Kejuruteraan Berbantuan Komputer) dijalankan untuk memastikan reka bentuk akhir boleh berfungsi seperti yang direka tanpa gagal. Analisis CAE telah dilaksanakan dengan menggunakan CATIA Analisis Struktur Generatif untuk menentukan tekanan Von Mises di seluruh bingkai dulang serba guna, dan juga pesongan dulang serba guna apabila beban dikenakan. Hasil daripada analisis CAE telah memastikan kejayaan konsep akhir. Reka bentuk konsep akhir mematuhi standard yang ditentukan oleh *American Public Transit Association* (APTA).

ABSTRACT

The final year project was focus on the total design of the multipurpose tray for Keretapi Tanah Melayu (KTM) train seat. The multipurpose tray design must able to function as food tray and perform addition function. In the initial stage of the project, the objective, scope and problem statement was determined. The objective of the project is to design a multi-purpose tray for KTM train seat. The problem statement is some of the old food tray used in KTM train seat was broken and cannot function as what it designs for. To replace those old food trays, a new food tray design with multi-purpose is required. The design process of the multipurpose tray design was following the total design process. A brainstorming session was conducted to generate some ideas of conceptual design. Besides that, a simple survey was conducted to found out the customer requirement and their opinion about how the food tray design should be. The conceptual design generated based on input from survey and brainstorming session is evaluation by weighted objective method for select the final design. The support frame of the final design of multipurpose tray will undergo calculation and CAE (Computer Aided Engineering) analysis to make sure the final design can function as designed without fail. The CAE analysis was perform by using CATIA Generative Structural Analysis to determine the Von Mises Stress across the multipurpose tray frame, and also translational displacement of the multipurpose tray when load is applied. The results from the CAE analysis were analyzed to make sure the successful of final concept. The final concept design was selected which is the most suitable to match the industry requirement.

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LIST OF SYMBOLS

| | | |
|----------------|---|----------------------------------------|
| F_y | = | Vertical Force, N |
| R_i | = | Reaction Force, N |
| V_i | = | Shear Force, N |
| M_i | = | Bending Moment, $N \cdot m$ |
| S | = | Section Modulus. m^3 |
| δy | = | Deflection at vertical direction, mm |
| I | = | Moment of Inertia, m^4 |
| b | = | Width of the cross section, m |
| h | = | Depth of the cross section, m |
| σ_{max} | = | Maximum Normal Stress, Pa |
| σ_y | = | Yield Stress, Pa |

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

The final year project or called Projek Sarjana Muda (PSM) is compulsory subject or project for final year engineering students in order to complete their degree study. The title of project is total design of multipurpose tray for KTM train seat. The KTM train seat equipped with food tray because food is served inside the train especially for passengers that travel long distance. The passengers that travel long distance may sit more than 10 hours, example from Tampin KTM station to Kota Bharu take around 11 hours. Hence, the KTM train was serve food inside the train to provide complete service to passengers. The current food tray design that used at KTM train seat is studied. There are other transports also equipped with food tray like buses, airplane and also vehicles. Tray is tool that used for hold things, but the multipurpose tray state in this project is more to food tray with multipurpose. The Figure 1.1 has shown the original design of KTM train seat with food tray. In this project, the design of the multipurpose tray must meet certain standard set in the early stage. One of the requirements for the multipurpose tray design must able to function as food tray at long distance KTM train seats. The multipurpose tray is design to install at the back of KTM train seat and perform more function compare to normal food tray, which is used for holding food only. However, the focus of this research is more about the design of multipurpose tray functions. There was only simulation software is used for analysis and no prototype testing will be conducted for this research. Figure 1.1 shows the original design of KTM train seat food tray.



Figure 1.1: The original design of KTM seat with food tray

1.2 PROBLEM STATEMENT

The KTM train has been operated for long time ago. Some of the long distance travel KTM train was equipped with old seat and food tray design. The KTM train seat and food tray design differ with different train. Some of the old food tray was broken and cannot function as what it designs for. To replace those old food trays, a new food tray design with multipurpose is required. The new food tray design must be able function like the old food tray, and able to provides more functions to attract the KTM train company to replace the old food tray (TKH Manufacturing 2012).

1.3 OBJECTIVE

The objective of the project is to design a multipurpose tray for KTM train seat

1.4 SCOPES

The scopes of this project include the studies of the existing food tray design at trains. The studies not only focus on the existing food tray design, but also the total design of the KTM train food tray which including the structure that supports the food tray. Besides that, the behavior of KTM train passenger is considered during the food tray design process. The KTM train passenger behavior and the comfortable level of existing KTM train food tray is study through survey. The engineering design method like total design process and weighted objective method involved generating the conceptual design and selecting the final design. The final design will be drawn by computer drawing software CATIA, continue with analyze by Computer Aided Engineering (CAE).

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION TO KTM TRAIN

Passenger transport railway train consisting in plurality of vehicles, where the plurality of vehicle is joins in permanent way by pairs of rail bogies positioned respectively at the end of the vehicle. The vehicle is covered by enclosed frame supported by the bogies, where a roof united by sides wall. The internal of the vehicle equipped with electrical system component to supplying electrical power for the operation system within the vehicle (Panagin and Romano, 1995). KTM Komuter is a commuter train service introduced in Malaysia in 1995 and operated by Keretapi Tanah Melayu Berhad (KTMB). The service provided by KTM Komuter included transportation between intracity and transportation between intercity. Figure 2.1 had shown the picture of KTM komuter train that operates in malaysia.



Figure 2.1: Picture of KTM Komuter Train

Spaces within the passengers train are equivalent to the numbers of passengers and also comfort for the passengers. The transport organization is interest to maximize the space inside the train to increase the numbers of passengers. The seats inside the passengers train are arranged in row (Kingsley *et al.* 2007). The passengers seats consists of a support frame having support legs and carrying a seat and a backrest. The comfortable level of the seats is not the main focus of the seats design, but also the seat safety during operation of the train or vehicle. The seats must capable to withstand high impact and without forming splinters, to protect the passengers sit on it (Kleinsteinbacher. 1981). To improve the comfortable level of KTM Komuter passenger, seat and facility play an important role.

2.2 INTRODUCTION TO TRAY

There are many types of trays been used in our daily life, those trays are named and differentiation according to its function. Some of the trays are concession tray, nursing tray, lap tray for carrying food, and also oven able food product tray. Concession tray is type of tray that normally used at concert, theatres or sporting event like football game, where the seats are arrange in multiple row. The tray is installed at the back of seat for audiences to put food and drink (Baggott, 2008). Nursing tray is used in medical for organizing and holding items. The tray is used to transporting or organizing medicine for nursing, treating or feeding to a patient (Madina, 2011). Lap tray for carrying food is a type of tray that design for fast food especially for passenger in motor vehicle. The tray design is simple and low cost, normally prepared by fast food restaurant for take away customer (Sussman, 1996). Oven able food product tray is tray that design for place together with food product directly into a microwave oven. This tray design for avoid extra step of removing the food product from the food package when put the food product into the microwave oven for heating (Paul, 1996).

Ergonomics serving tray is a tray with special design where the tray design is easy to carry, lift and set down even with single hand. The design of tray is easy used by human (Dafna, 2012). Figure 2.2 had shown the drawing of the food serving tray.

A food serving tray could be made from different types of materials like ceramic, plastic and other types of similar materials. Most food serving tray is preferably made from polystyrene foam (Ramirez and Bergeron, 2002). The basic requirement of the food serving tray is must have a food and beverage compartment, where the food serving tray consist of cup cavity, a plate cavity and an eating appliance cavity. Besides that, the food serving tray as illustrate in Figure 2.2 must have handle to allow individual to easily pick up and carry food with one hand only (Lanita, 2009; or Manuel *et al.*, 1995).

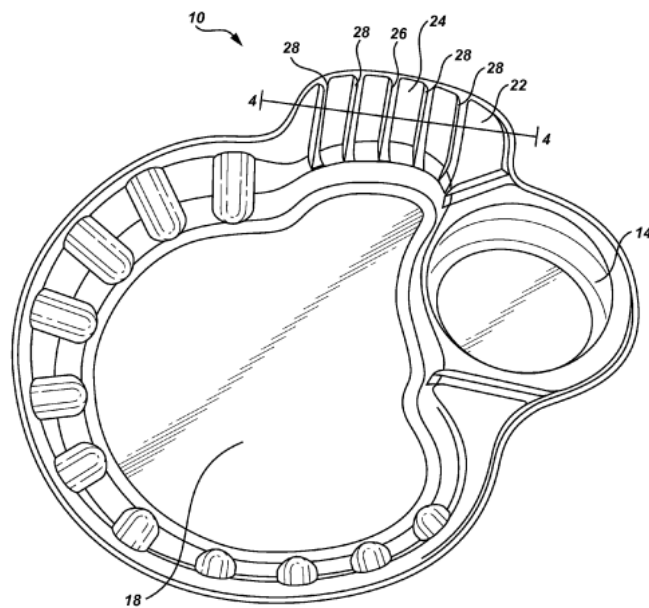


Figure 2.2: Food serving tray
(Source: Lanita, 2009)

2.3 CURRENT FOOD TRAY DESIGN

The ideal of develop food or beverage tray come from the problem of serving and consuming food or beverage. The passenger of vehicle or guest do not have table for holding plate, it was difficult for passenger or guest to eat when both hand are occupied by food plate and cup of drink (Funchum and Sheehan, 1994). Many individuals are often consuming food product or beverage within the vehicle, either passenger or driver. This action may bring inconvenience and dangers while the driver operating the vehicle. The automobile food trays can reduce this problem but

not solve it, because the food tray are limited in the number of permutations of food array due to different sized of beverage cups and food container (Sgrignoli, 2004). The food tray is designed to use by driver, occupant or passenger in motor vehicle. Due to the growth of fast food outlets, more driver or occupant of vehicle are having their food inside the motor vehicle and the beverage cup receptacles mounted at the vehicle is not enough for used (Sandra, 1991).

Other than that, there are many types of trays design with special purpose like easy to clean, ergonomics, easy to carry, and special function. Easy clean food tray is a food tray that design to skip unnecessary procedure during cleaning process. This kind of food tray is installed at back of the seat. The food tray is design to wipe down when cleaning and save time as the food tray can stow after cleaning process (Tom, 2003). Folding lap tray is type of food tray that design for easy storage and transport. The special of the folding lap tray is that this food tray can be temporarily bonded in any places and even can grip with user legs (Miller and Setterlund, 1995). The folding lap tray design is shown in Figure 2.3 Besides that, food service tray with cutlery is food service tray that can be throw away after used, normally this type of food tray is made of plastic materials. The special of this food tray is containing a rectangular compartment to store food items like spoon, fork and a knife (Paul, 1972).

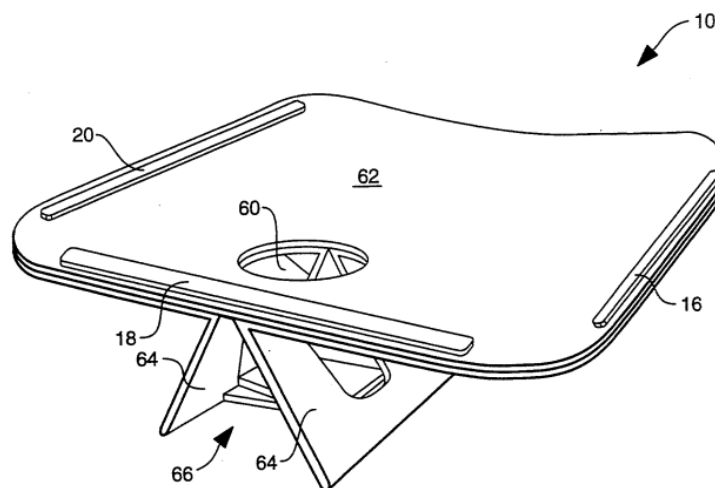


Figure 2.3: Folding lap tray design
(Source: Miller and Setterlund, 1995)

Food and activity tray, type of tray that design not only for food and beverage but also a work surface or activity surface for recreation purpose. Figure 2.4 had shown the food and activity tray. This kind of food tray provided surface for different food or beverage packages. Besides that, the food tray also provided activity surface for simple game and other entertainment purpose (Sgrignoli, 2004). There is an ideal about food tray with non-slip inserts. This tray system normally consists of one or more retaining portions to hold food container or beverage. The non-slip inserts is fitted into the portion to increase the grip on the serving tray to hold the food container and beverage in position. The non-slip inserts can be removing for ease of cleaning and prevent build up of dirt. Other that than, the non-slip inserts may change its color according to different design of the food tray (Hatcher, 2007).

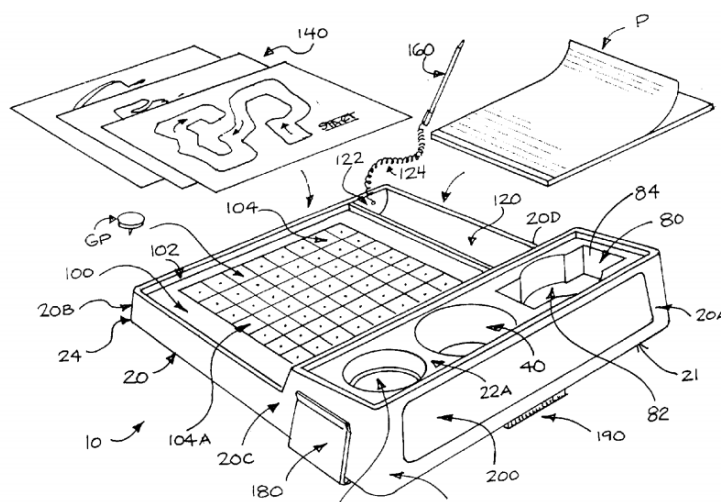


Figure 2.4: Food and activity tray

(Source: Sgrignoli, 2004)

Other type of current food tray design is supportable food tray with bib, where the tray consists of upper surface which is divided into few partitions. Figure 2.5 had shown the drawing of supportable food tray with bib. Every partition at the supportable food tray design with different purpose, the circular partition is for cup holder and other partition as food holder. A bib portion is design with sufficient length to extend upward for reach the upper torso of the person. The bib portion consists of pair of shoulder attachment. The shoulder attachment at the bib portion can be adjusted vertical and horizontal according to the user (Hayward, 1997). There is a tray special design for children. The tray is built with base and a superstructure