



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DESIGN OPTIMIZATION USING FINITE ELEMENT
ANALYSIS**

This report submitted in accordance with the requirements of the Universiti Teknikal
Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering
(Design) with Honours.

By

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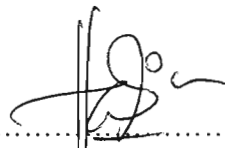
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APPROVAL

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ABSTRACT

Design is important stage in manufacturing. It is because any product produced must be through design stage where in design stage consist conceptual design, concept selection, identify customer need, concept selection, analysis and others. In design, it should be consider many factors such as product design must be satisfied by customer, material used the ability product to work and others. All part in design is to fulfill customer need. Beside that design will give an effect to company such as profit, loss and reputation of the company. This projects study deep on design optimization using finite element analysis. Where the product to be study is drain cover design. In this project consist the survey the existing drain cover, redesign and improve the existing drain cover until the drain cover get the better design and best of result analysis. Beside that this project also provides optimization process. This optimization process done in redesign process, where the current design will change the shape, size or others until the drain cover have best result of analysis. In this project material to be used is Fiber Rainforest Glass (FRP) because the drain covers to be design just for avoid the stolen case if using the steel material for standard. Finally this project are guide by three main objective, firstly to redesign and improve existing drain cover, to analyze drain cover using Finite Element Analysis and lastly to optimize composite drain cover design.

ABSTRAK

Rekabentuk adalah merupakan peringkat yang paling penting dalam sektor pembuatan. Semua produk digalakkan terlebih dahulu melalui peringkat ini dimana peringkat rekabentuk ini mengandungi konsepsi rekaan, pemilihan rekabentuk, mengenalpasti keperluan pengguna, pemilihan konsep, fasa analisis dan sebagainya. Beberapa faktor yang perlu diberi perhatian didalam rekabentuk diantaranya rekaan produk yang akan memenuhi kehendak pengguna, bahan yang digunakan dan sebagainya. Kesemua produk hendaklah mencapai keperluan dan kehendak pelanggan dan pengguna. Namun rekabentuk juga berupaya memberi kesan kepada syarikat samada keuntungan, kerugian atau reputasi prestasi syarikat itu sendiri. Projek ini membuat kajian dalam memperkasakan (optimum) rekabentuk dengan menggunakan analisis elemen finiti. Dimana produk yang dikaji adalah penutup longkang. Projek ini juga menjalankan survei keatas penutup longkang yang sedia ada, merekabentuk semula dan meningkatkan rekaan sehingga mencapai keputusan yang baik dalam menganalisis suatu rekabentuk. Selain itu projek ini juga melibatkan proses perkasaan (optimum). Proses perkasaan ini terhasil didalam pproses merekabentuk semula, dimana rekaan asal akan diubah dari segi, bentuk saiz dan lain-lain sifat sehingga penutup longkang mencapai keputusan analisa yang terbaik. Sepanjang projek ini bahan yang digunakan didalam penutup longkang adalah gentian kaca berstruktur kerana untuk mengelakkan kecurian bahan berunsurkan keluli. Akhir kata projek ini dijalankan dengan berpandukan kepada tiga objektif utama iaitu untuk merekabentuk semula dan meningkatkan rekaan penutup longkang yang sedia ada, untuk menganalisis penutup longkang menggunakan analisis elemen finite dan yang terakhir untuk memperkasakan (optimum) rekaan penutup longkang berkomposit.

DEDICATION

*Dedicated to my father, Mohamad Fazee bin Abd Aziz and my mother, Zilis Binti Mohamad.
To my supervisor, lecturers and friends for all of their help and friendship.*

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LIST OF ABBREVIATIONS, SYMBOLS & NOMENCLATURE

CAD	Computer Aided Design
FEA	Finite Element Analysis
FRP	Fiber Reinforest glass
HDPE	high-density polyethylene
QFD	Quality Function Deployment
CAE	Computer Aided Design Engineering
IGES	CATIA File format
STEP	CATIA File format
CATIA	Computer Aided 3D Interactive Application

CHAPTER 1

INTRODUCTION

1.1 Project Background

Today computer is one of the most important equipment in design and manufacturing industry. It is also gave an impact more in the industrial sector. Computer is used for various activities in the industries. However in manufacturing industries it made a very substantial change in their working. The computer does not only used to simplify many of the traditional manufacturing tasks but also made it almost impossible for manufacturing industries to survive in the modern ere without it. Thus it is important for everyone concerned with the manufacturing industries to learn the use of computer among the usages of computer in manufacturing, Computer aided design and Computer aided manufacturing (CAD/CAM) are by far the best known as well as the best application. In order to remain competitive in the global economy, it is imperative that all manufacturing industries adopt CAD/CAM.

In the earlier days of CAD/CAM development the cost used to be prohibitive and did not allow the small and medium scale industries to adopt it. However, this has changed since the invention of the microprocessor and the rapid developments taking place in the very large scale integration (VLSI) of the electronic circuit. The cost of computing equipment in the present stage is relatively low, and this allowed the devolvement of large for these powerful computers. The mass manufacture techniques employed for the manufacture of computer have further reduced the cost. This has allowed the small and

medium scale companies to use the powerful computers in their day to day operations. Along with the developments in the hardware, the software, too, continued to develop at a similar pace. The present day software is easier to use and very powerful, thereby guaranteeing the result in a much shorter time than was possible earlier. This has prompted the small and medium scale to enterprises to embrace CAD/CAM in a big way in the development world. It is, therefore, not uncommon to see even small companies using CAD or CAM in to improve their productivity.

CAD/CAM is related to the design where design is an activity which needs to be well organized and takes into account all influence that are likely to be responsible for the success of the product under development. A product here means single components, which is functional in itself like a wrench or an assembly of large number of part or component all of which will contribute to he functioning of the part such as an automobile engine. In design, it has stages of the design process. The flow of design process such at the below:

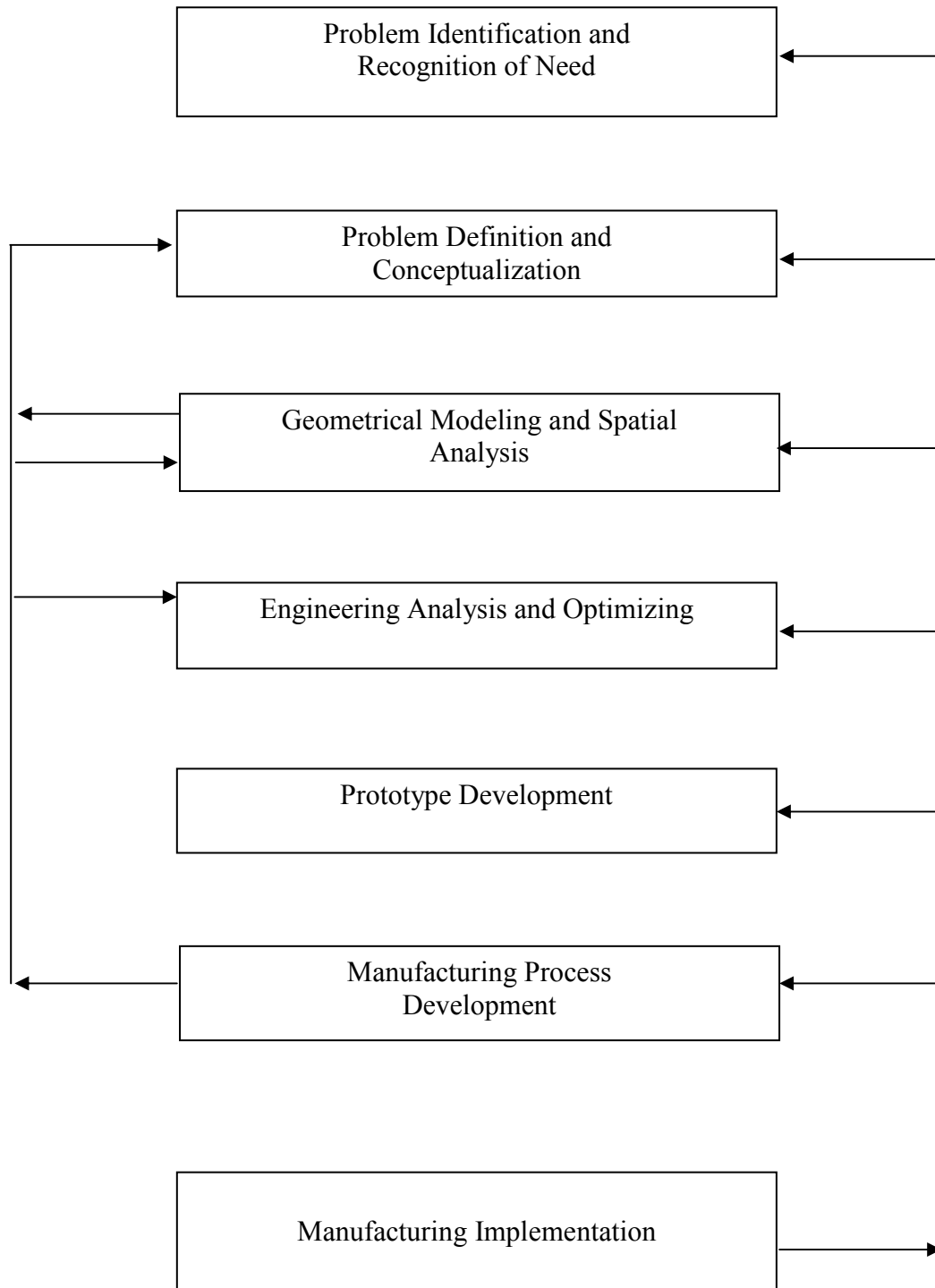


Figure 1.0: Stages in the design process

To design, CAD technology is used. CAD or computer aided design is the use of computer method to develop the geometric model of the product in the three dimensional form, such that the geometric and manufacturing requirements can be examined. Many type of cad software can be use such as SOLIDWORK, CATIA, INVENTER and other. CATIA software is CAD/CAM family software but it one of the best CAD software and that suitable for this project. CAD technology is used because CAD technology can provide the necessary help in the following below:

1. Computer Aided Design (CAD) is faster and more accurate than the conventional method.
2. The various construction facilities available in CAD would make the job of developing the model and associated drafting a very easy task.
3. In contrast with the traditional drawing method, under CAD it is possible to manipulate various dimensions, attributes and distances of the drawing element. This quality makes CAD useful for design work.
4. Under CAD work will never have to repeat the design or drawing of any component. Once a component has been made, It can be copied in all further works within seconds including any geometric transformation need.
5. Modification of a model is very easy and would make the designers task of improving a given product simple to take care of any future requirement.
6. Use of standard component makes for very fast model development work.

Then for the next process after product design is do an analysis of the product. Where it is used finite element analysis as a tools. The finite element analysis (FEA) is a very powerful analysis tool, which can be applied to a range of engineering problem. The finite element modeling process allowed for discrediting the intricate geometries into small fundamental volumes called finite element. It is then possible to write the governing equations and material properties for these elements. These equations are then assembled by taking proper care of results that describe the behavior of the original

complex body being analyzed. Application of FEA is no limited to mechanical system alone but to range of engineering problem such as stress analysis, dynamic analysis, and deformation studies fluid flow analysis, heat flow analysis and other.

With the FEA software it is possible to try a number of alternative designs before actually going for a prototype manufacture. The use of FEA tools can converting the geometry into discretised element and calculating various properties for each element such as geometry, material properties, constraint and loading. This forms the input for the analysis. It also can generating the finite element mesh by making a suitable approximation to the geometry. Then it can calculate the nodes and element properties and allowed the material properties to be specified. Under FEA it has steps involved in the use of finite element method for solving a physical problem. The software used for run this Finite Element Analysis such PATRAN and CATIA.