DESIGN & IMPROVEMENT (TRASH TRAPPING COMB) OF TRASH COLLECTOR SYSTEM (DEPLOY ON MELAKA RIVER CRUISE BOAT) CONVEYOR TYPE MECHANISM.

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Bachelor of Mechanical Engineering Technology with Honors

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A thesis submitted in fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology with Honors

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DECLARATION

I declare that this "DESIGN & IMPROVEMENT (TRASH TRAPPING COMB) OF THRASH COLLECTOR SYSTEM" is the result of my research except as cited in the references and has not been accepted for any degree and is not concurrently submitted in the candidature of any otherdegree.

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Date : 21 JUN 2023

APPROVAL

I hereby declare that I have checked this thesis, and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Mechanical Engineering Technology with Honors.

Signature : ………………………………..

Supervisor Name : MOHD FARIDUDDIN BIN MUKHTAR

Date : 12 JANUARY 2024

DEDICATION

This final year project is dedicated to my supervisor, MOHD FARIDUDDIN BIN MUKHTAR, and my co-supervisor, for their endless hours of reflection, reading, encouraging, and, most importantly, patience throughout the project. This project is also dedicated to my parents, who are the motivating and supporting my efforts to complete the project successfully. Thanksfor the encouragement and support.

ABSTRACT

River water pollution has received a lot of attention recently and is still a big worry for people all around the globe. The problem of population growth and city expansion is the main factor contributing to the decline in water quality. The availability of drinking water, economic growth, and the health of the environment are all at risk from this. Indirect human activities that benefit society financially have degraded the river's water quality. There are several different causes of water pollution in the Malacca River, including waste pollutants and feces waste. It will taint and lower the quality of the river's water. Residents in Alor Gajah and Melaka Sentral have endorsed the issue that the river's water quality has significantly declined because of garbage pollution, and so has the state government. The Malacca River's trash is now being removed using a trash collector system. The thrash collector system will be more useful in making the river clean. Trash trapping comb will be a separate part of the thrash collector system. The trash in system will be guided by the trash trapping comb. Waste will be gathered. To solve the garbage issue on the Malacca River, the apart from thrash collector system, which means trash trapping comb, will be developed. To ensure that the Environment-Conveyed Automated loT PONTOON (En-COOTIP) is fully functioning, a field test will also be conducted at the Malacca River. The enhancements that are desired are anticipated to be strong, light, and satisfy all needs and concerns.

ABSTRAK

Sejak beberapa tahun kebelakangan ini, air sungai yang tercemar telah mendapat banyak perhatian, dan ia terus menjadi punca kebimbangan utama di seluruh dunia. Pembangunan penduduk dan perluasan bandar dikatakan dikaitkan dengan kemerosotan kualiti air. Ia menimbulkan ancaman kepada pembangunan ekonomi, bekalan air minuman, dan kesihatan ekologi dan manusia. Kualiti air sungai telah terjejas secara tidak langsung oleh aktiviti manusia yang menghasilkan keuntungan kewangan kepada masyarakat. Sisa dan sisa najis adalah antara pelbagai sumber pencemaran air di Sungai Melaka. Ia akan merendahkan kualiti air sungai dan mencemarkannya. Penduduk tempatan di Alor Gajah dan Melaka Sentral, serta kerajaan negeri, menyatakan bahawa kualiti air sungai telah terjejas secara drastik akibat pencemaran. Satu projek yang dipanggil Environment-Conveyed Automated loT PONTOON (En-COOTIP) akan membantu mengumpul sampah sampah di Sungai Melaka dengan menggunakan bot pembersihan. Pemungut mengumpul sisa pepejal yang besar ke dalam bekas untuk mengelakkan tersumbat. Sebuah konveyor akan dibangunkan dalam projek ini untuk menangani isu sisa pepejal di Sungai Melaka. Untuk memastikan bahawa Environment-Conveyed Automated loT PONTOON (En-COOTIP) berfungsi dengan baik, ujian lapangan tambahan akan dijalankan di Sungai Melaka. Penambahbaikan yang dimaksudkan akan ringan, berkuasa tinggi dan memenuhi semua kriteria dan keperluan.

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I wish to express my sincere appreciation to all those who contributed to the successful completion of this report. Initially, I express my gratitude to the divine being for endowing me with numerous concepts and proficiencies, along with optimal physical well-being, thereby facilitating the accomplishment of this undertaking.

To attain the aim of my project, extensive research was conducted through various sources such as online databases, scholarly articles, published literature, and academic journals, including the analysis of previous year's theses. I would like to acknowledge the individuals who provided me with the necessary encouragement and support to successfully complete my final year project thesis.

I would like to extend my appreciation to my esteemed supervisor,MOHD FARIDUDDIN BIN MUKHTAR, for his invaluable guidance, unwavering patience, exceptional assistance, motivational influence, and comprehensive comprehension during the course of my Final Year Project at University Technology Malaysia Melaka (UTeM). The guidance he provided proved to be of great worth in facilitating the accomplishment of my task.

I would like to express my gratitude to my entire family for their unwavering support and guidance, which they provide with love. Additionally, they provided ample motivation which facilitated the completion of this project.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

As the name implies, an Environment-Conveyed Automated loT PONTOON (En-COOTIP) is a device or component designed to trap or catch rubbish or debris. It is often utilized in trash collecting and waste management systems or procedures.

Figure 1 Environment-Conveyed Automated loT PONTOON (En-COOTIP)

At the river's surface, an automatic trash collector collects rubbish. A trash collector system, also known as a waste management system or garbage collecting system, is an infrastructure and process that collects, transports, and manages solid waste or trash from multiple sources. These systems are critical for preserving community cleanliness, hygiene, and environmental sustainability. Trash, often known as trash or rubbish, is any undesired or abandoned substance that is no longer required or helpful. It is often made up of numerous solid items, chemicals, or byproducts of human or natural processes. Trash cans include packaging materials, food leftovers, paper, plastics, glass, metal, textiles, electronics, and other stuff. Anything of little or no value such as items that are no longer functional or desired and have been discarded (Merriam Webster,27 April 2023).

Figure 2 River pollution in Malaysia (Merriam Webster,27 April 2023)

Too much amount of trash may cause pollution. The contamination or degradation of rivers and water bodies caused by the introduction of dangerous chemicals or contaminants is referred to as river pollution. It is a serious environmental concern that may have a negative impact on ecosystems, human health, and water supplies. Environment-Conveyed Automated loT PONTOON (En-COOTIP) enable us to gather enormous volumes of plastic pollution from streams, including trash trapping combplastics, which are notoriously difficult to collect by hand and data collection on what these traps redirect helps to improve local and worldwide upstream solutions (ICC ,April 2023).

Trash Trapping Comb known as Trash trapping comb is a component in Environment-Conveyed Automated loT PONTOON (En-COOTIP). Trash trapping comb is an easy way to transport the trash in conveyor in Environment-Conveyed Automated loT PONTOON (En-COOTIP). In a conveyor system, a trash trapping comb is a component or device included inside a conveyor belt or conveyor system to collect or block the transport of waste or debris along the conveyor route.

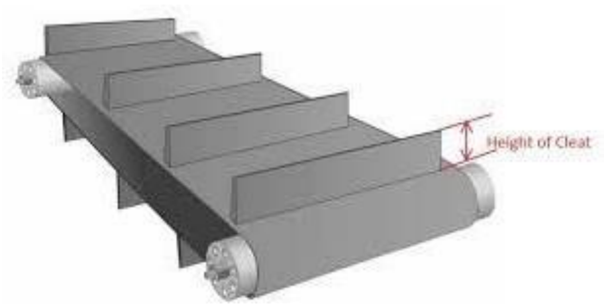


Figure 3 Example of Trash trapping comb in convethis projectr (ICC 2023 - Ocean Conservancy,4 April 2023)

This sort of comb is intended to trap or collect undesired items such as tiny pieces, loose trash, or litter, stopping them from moving further down the conveyor line. In this research the trash trapping comb in conveyor system is used to carry the trash from the place it collected. Out of 31.9 million MT of mismanaged plastic trash, an estimated 4.8 to 12.7 million metric tons (MT) reached the ocean in 2010. Malaysia is rated eighth out of 192 coastal nations with high levels of unmanaged plastic garbage. In Malaysia, approximately 0.36 million of the 0.90 million tons of unmanaged plastic trash had degraded into plastic marine debris. Furthermore, the Ministry of Natural Resources and Environment (NRE) announced in 2012 that 41.00% of Malaysian rivers were classed as contaminated based on the Water Quality Index (WQI). When we look in worldwide, The Ganga is India's most significant river system. Because of the abundant supply of water throughout the year, it has played a significant role in the development of Indian civilization and economics. It provides 25% of India's water resources. The Ganga is the world's thirty-first longest river, with a basin size of 861,404 km2. With a population density of 520 people per square kilometer, the Ganga basin is one of the world's most densely inhabited locations. Moreover 300 million people live in the basin across India, Nepal, and Bangladesh (Paul, 2017). The Ganga basin, which has a rich history, cultural, and religious qualities, drains approximately 1,060,000 km2 and is the world's fifth biggest. One-fourth of the Indian subcontinent is drained by the river system. In India, the Ganga River flows through 29 class I cities, 23 class II cities, and around 50 towns, resulting in the release of various sorts of pollutants such as industrial, sewage, and so on into this enormous river eco-system. This happened because there is lacking waste management or trash collecting system in river (Zakariah et al., 2021).

When we talk about our country, Melaka River was also polluted. Melaka, often known as Malacca, is a Malaysian state with a rich history and cultural legacy. Melaka, like many other parts of the world, is not immune to the problem of river pollution. Melaka river pollution has a variety of causes and repercussions that harm the environment, human health, and local communities. Here are some significant elements about Melaka's river pollution.

Figure 4 River pollution in Melaka (Zakariah et al., 2021).

To prevent the issue from becoming more serious in the future, we should start to do prevention of the ocean pollution by starting to avoid the waste in the river flow into ocean. Therefore, we make trash trapping comb known as Trash trapping comb that used in conveyor to support the Environment-Conveyed Automated loT PONTOON (En-COOTIP) trash collecting system to help solve the issue. Hundreds of freshwater fish were discovered dead along the historic Sungai Melaka canal following a significant pollution disaster caused in part by the discharge of industrial trash (21 May 2019). The benefits of this approach, on the other hand, are that we can reduce the cost and utilization of labor for cleaning the waste from the Melaka River. We were also able to make the cleaning procedure easier and save time in the future by employing an automated method instead of the old style of river cleaning, which used personnel to collect rubbish from the surface of the Melaka River. Furthermore, Melaka River may remain clean if the cleaning method is efficient. Tourists may be drawn to Malacca because of its clean atmosphere, which might boost the Malaccan economy and perhaps our country's. Finally, a clean river may help to preserve the river's aquatic environment.

1.2 PROBLEM STATEMENTS

Trash in waterways has grown as a major environmental concern globally, especially in Melaka. Trash buildup in rivers has a variety of environmental and socioeconomic consequences, including threats to ecosystem health, water quality, and human well-being. Thus, tackling the problem of garbage in rivers is critical for conserving the natural environment and protecting communities' livelihoods. The substantial buildup of rubbish in rivers creates a serious environmental and ecological concern that must be addressed immediately. River pollution has become a major worry, impacting the health of ecosystems, the availability of clean water supplies, and the overall well-being of populations who rely on these rivers. The contamination of rivers with dangerous elements such as industrial waste, sewage, agricultural runoff, and chemical pollutants is referred to as river pollution. This pollution causes several severe environmental, social, and economic concerns, including water quality degradation, harm to aquatic ecosystems and biodiversity, health hazards for humans and wildlife, and a restricted supply of clean water for diverse reasons. River pollution needs immediate attention and comprehensive solutions to ensure the conservation and restoration of river ecosystems, as well as the sustainable use of water resources.

In Malaysia, treated water provided through the public supply system must meet the National Water Quality Standard guideline published by the Ministry of Health (KKM). The Interim National Water Quality Index (INWQI) and Water Quality Index (WQI) established by the Ministry of Environment are used to classify river water. Malaysia relies mostly on surface water, such as river water, to provide water treatment facilities to customers.

As a result, raw water quality, particularly river water, must be checked since dirty river water will result in higher water treatment expenses. In Malaysia, purified water delivered through the public supply system must meet the requirements established by the Ministry of Health (KKM) which is the National Water Quality Standard guideline. The Interim National Water Quality Index (INWQI) and Water Quality Index (WQI) established by the Ministry of Environment are used to classify river water.

According to The Star (Sungai Udang Farmers Protest Pollution of River, Say It Affects Their Livelihoods, 2022), a group of around 60 farmers in Sungai Udang believe that hazardous contamination of a river used for irrigation has badly impacted their source of income.According to Mohammad Abd Rahman, chairman of the Paya Rumput Jaya Smallholders' Association, river pollution has harmed their agricultural areas, notably banana and Musang King plants.

According to (Free Malaysia Today,19 February 2023,Lim Ban Hong), the contamination of Sungai Lereh is considered to be the result of sewage dumping from cattle and goat agricultural operations.After receiving complaints from nearby people, the Melaka Department of Environment (DoE) took water samples from the river.Melaka DoE and the Department of Veterinary Services (JPV) reported that the river was polluted and that they were investigating whether the sewage system or the functioning of the retention pond in the enclosure area complied with the requirements established.Residents in the vicinity of Sungai Lereh also stated that the river was polluted about every three months.

It is impossible to overstate the importance of rivers to human existence and progress. Rivers are important to humanity because they are more than simply important hubs of biodiversity and refuges for threatened species. The river is crucial for agriculture, transportation, energy supply, human economy, and drinking water. However, floating debris, oils and other hydrocarbons, industrial waste, and other pollutants now poison the majority of rivers.

In Malacca, where there have long been serious problems with water pollution that have led to the extinction of aquatic species along the Malacca River (Sinar Harian Online, 2016; Hua, 2015; Metro Online, 2015; Daneshmend et al., 2011), this is not a brand-new phenomenon. In 2008, Malacca State became a popular tourist destination for the nation when UNESCO named it a World Heritage Site (UNESCO, 2016).

Figure 5 Malacca River Cruise (UNESCO, 2016).

Since the Melaka River Cruise is a popular tourist attraction and Melaka is heavily dependent on the tourism sector, the government of Melaka must address water pollution in the Malacca River. Visitors will be given a tour of Melaka aboard the ship. The Malacca River stinks especially bad owing to water contamination from plastic, food and drink containers, and human apparel. Oil, chemicals, and radioactive waste from industry are other sources of the aroma that led to the fishes' demise.

Figure 6 Death fish because of polluted water

The Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP) was developed with the intention of making the surrounding environment cleaner as a primary focus. The primary purpose of the Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP) is to transport the trash that are collected at above river to system and to clear the surface of the river of floating garbage, debris, and dead fishes. The Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP), also known as Trash trapping comb, has been fitted with in conveyor, which is in pontoon, so that it may be floated down the Malacca River. This enables to function as a floating trash trapping conveyor.Trash trapping comb has been attached to the Environment-Conveyed Automated loT PONTOON (En-COOTIP) at top of conveyor frame.

1.3 RESEARCH OBJECTIVE

The reduction of water pollution is the fundamental objective of this project. This will be accomplished by designing and fabricating The Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP) and determining how to create a lightweight material with great strength. Specifically speaking, the goals or the objectives are as detailed below:

i. Design light weight trash trapping comb of trash collector system in river using Pugh method.
ii. To analyze the mechanical structure of trash trapping comb for trash collector system using finite element analysis.

1.4 SCOPE OF RESEARCH

The exact objectives, deliverables, activities, and resources that are involved in the execution of a project are referred to as the scope of that project. The scope specifies the elements that will be included in the project as well as those that will be left out. It establishes the bounds of the project and specifies the parameters of its execution. The following is the scope of this research to create the Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP) to minimize weight using SOLIDWORKS.Moreover,to use SOLIDWORKS to conduct an examination of the Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP) to boost its strength.Besides,to manufacture The Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP) using both traditional and advanced production methods.Finally,to choose the material with the highest possible quality at the lowest possible cost and with the longest possible lifespan for The Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP).

1.5 ORGANIZATION

In this chapter, we discussed about the background study of this project. Trash, also known as trash or rubbish, is any unwanted or abandoned substance that is no longer required or helpful and has been discarded. A trash collector system, also known as a waste management system or garbage collecting system, is the infrastructure and process that collects, transports, and manages solid waste or trash from multiple sources. Waste contamination in the Melaka River is the primary topic of this investigation. At the outset, the problem at hand as well as the goals and parameters of the whole project are briefly outlined. The next step is to read up on related projects and become inspired. Then, the procedures are outlined. The garbage collector manual is then dissected in detail. The conclusion is drawn at last.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this section, we will do the project's background research and literature evaluation by reading relevant papers, book reviews, and journals. In this section, we'll discuss the software behind the scenes of the Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP), a device designed to clean up polluted water. By reviewing the relevant literature,it may have a better grasp on the project, as well as get insight into the relevant research and evaluate the project more accurately.

2.2 WATER POLLUTION

Now that water pollution has reached epidemic proportions over the world, it is imperative that water resource policy be constantly assessed for effectiveness. Worldwide, water contamination is a leading source of death and illness. Fourteen thousand persons per day are lost to water-related illnesses, according to FN & MF (2017). Water contamination is an issue in both developed and developing nations (FN & MF, 2017). Precipitation, temperature, soil type, vegetation, geology, floZ conditions, ground water, and human activities are only a few of the numerous elements that impact water quality. Point sources, such as those found in factories and cities, are the biggest danger to water quality. Water quality may also be impacted by industries including mining, urban planning, and agriculture. In addition to nutrients, sediments, and hazardous pollutants, non-point source pollution also includes these factors (FN & MF, 2017). A physical, chemical, or biological component that has undesirable or harmful impacts on aquatic life or humans who drink the water is considered a water pollution. However, the compounds that stay dissolved or suspended in water and cause an unpleasant environmental reaction make up the vast majority of water contaminants (Goel, 2012). Physical and biological elements may also contribute to pollution. Physical variables like temperature and radiation have substantial impacts on living things. Some of the trash trapping comborganisms found in water are considered biopollutants because they pose a health risk to humans and other animals.

Figure 7 Water Pollution in Ganga River (*Tsering et al., 2020).*

2.3 WATER POLLUTION IN MALACCA RIVER

Melaka has a total land area of 1,650 square kilometres (km square) and is subdivided into three distinct districts,Melaka Tengah, Alor Gajah, and Jasin. Melaka is a state in Malaysia that is open for tourism and has a rich cultural and historical legacy.

These assets offer a significant amount of potential in terms of the growth of the tourist sector in Melaka. Every year, the tourist sector displays a pattern of consistent growth. According to a report from (Utusan Malaysia 13 May 2014), the total number of visitors has increased from 1.9 million in the year 1992 to 12.6 million in the year 2013. As a result of this, in 2007, the organisation that falls under the state government and is known as the Perbadanan Pembangunan Sungai Dan Pantai/River and Beach Development Authority, Melaka (PPSPM) devised a plan to beautify and upgrade Melaka River to transform it into a centre of water sports, a recreational area, and a tourism attraction that could generate income for the country. When it comes to the cleaning service,An excursion of a lifetime was planned for a group of coworkers and family members of the Mahkota Parade management team, and they all met at the ticketing desk of the Melaka River Cruise as the morning sky were crystal brilliant and the sun was shining brightly. The management team of this company has chosen to develop a CSR campaign called "Jom Bersih Sungai Melaka" in connection with their Merdeka Campaign 2019 to clean up the Melaka River. This campaign will be run in association with the Perbadanan Pembangunan Sungai & Pantai Melaka (PPSPM) organisation, which is in charge of the Melaka River Cruise (LET'S CLEAN: THE MELAKA RIVER - CSR Malaysia, 2019).

Figure 8 Melaka cleaning team (LET’S CLEAN: THE MELAKA RIVER - CSR Malaysia, 2019)

Mahkota Parade wanted to build a deeper cooperative attitude inside the firm, raise awareness of responsibility among personnel, and have the joy of cleaning up the Melaka River, which is an image of the state. These aims were the goals of the CSR initiative that was established by Mahkota Parade. Mahkota Parade also has the hope that with the help of this effort, it would be possible to recruit many business and public sectors to participate in this kind of CSR activity, and that they will make a commitment to maintain the cleanliness of both the state and the nation at all times. This is in keeping with Mahkota Parade's objective of being a community mall that motivates the local populace to contribute in whatever way they can to the development of a better country (LET’S CLEAN: THE MELAKA RIVER - CSR Malaysia, 2019).

Figure 9 Mahkota Parade management team cleaning service (LET’S CLEAN: THE MELAKA RIVER - CSR Malaysia, 2019).

2.4 FUNCTIONALITY AND MECHANISM OF THE TRASH TRAPPING COMB IN ENVIRONMENT-CONVEYED AUTOMATED LOT PONTOON (EN-COOTIP).

These days, labour from PPSPM has been deployed to clean up all of the debris that has been drifting down the Malacca River.The weekly garbage collection has resulted in more than 5 tonnes of trash being removed. The garbage that is floating in the water is one of the primary contributors to the flash flood (Insight, 2019).

Figure 10Cleaning Melaka River (Insight, 2019).

Trash Trapping Comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP) was developed with the intention of collecting and removing floating trash.It is possible to collect rubbish, debris, and dead fish that have floated to the river's surface. The Trash Trapping Comb, also called a Trash trapping comb in Environment-Conveyed Automated loT PONTOON (En-COOTIP), is made up of two pieces that are independent from one another: the body and the comb.

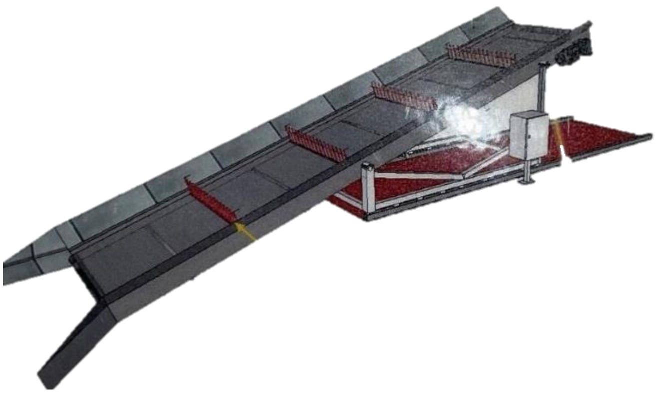


Figure 11 Design Environment-Conveyed Automated loT PONTOON (En-COOTIP

The Trash Trapping Comb is part of the Environment-Conveyed Automated loT PONTOON (En-COOTIP), and it may be found directly above the convethis projectr of the En-COOTIP.The cleaning boat, which will be called the Environment-Conveyed Automated loT PONTOON (En-COOTIP), will have a Trash Trapping Comb connected to it.

2.5 PUGH METHOD

The Pugh Matrix is a decision matrix that is based on criteria scoring, and it is used to decide which of a number of possible alternatives should be selected. The Six Sigma approach now incorporates this tactic as a necessary part of the process. Following the completion of VOC (Voice of the Customer) surveys and the building of a QFD (Quality Function Deployment), consultants will often use the Pugh matrix. Pugh Matrix is also known as choice matrix or grid, selection matrix or grid, problem matrix, opportunity analysis, criterion rating form, and criteria-based matrix. These are all names for the same thing.

The Pugh matrix gives the consultant the ability to easily compare several criteria (or characteristics) of a solution by arranging them in a predetermined order. A consultant may utilise this matrix to develop an ideal solution, which is a hybrid of other strong solutions, by combining the best features of each of those solutions. This matrix also offers an approach that is built on teams for the disciplined production and selection of concept ideas.

- Establish which user needs or criteria are absolutely required. The challenge presented by Melaka's polluted water supply.

- Calculate individual weights for each need. Regarding the score weighting, this is not required.it may able to accomplish this goal by using a variety of weighting techniques.
- Develop various designs.
- Determine the direction of the development by selecting one of the options shown as a design.
- In comparison to the baseline, assign a score of excellent, bad, or equal to each alternative in terms of how well it meets the criteria.
- Compute the total value of each option by multiplying each value by the weight associated with it, if the supplementary scoring system was used.

- To develop the best possible solution, combine the most advantageous aspects of each available option.

2.6 SOLIDWORKS CAD SOFTWARE

2.6.1 INTRODUCTION TO SOLIDWORKS

A mechanical design automation programme, the SOLIDWORKS CAD software enables designers to swiftly sketch out concepts, experiment with features and proportions, generate models, and produce comprehensive drawings.Many ideas and terms that are used all throughout the SOLIDWORKS programme. It will acquaint the functionalities of SOLIDWORKS that are most often utilised.Structured to mirror how to work with the SOLIDWORKS programme, and its organisation reflects that.It is organised in a manner that revolves around the fundamental SOLIDWORKS document types, which are parts, assemblies, and drawings. For instance, it will first need to design a component before can go on to creating an assembly (Radziwill, 2017).

The SOLIDWORKS design process is a three-dimensional one. Develop a 3D model of the component are designing from the very first sketch all the way up to the finished product.It generate 2D drawings from this model, or can make 3D assemblies by mating components that are made up of parts or subassemblies to one another. Have the option of producing 2D drawings of 3D assembly.When creating a model using SOLIDWORKS, have the ability to see the model in three dimensions, just as it will appear after the model has been made (Radziwill, 2017)

SOLIDWORKS is a programme that is used by millions of designers and engineers and is utilised by hundreds of thousands of businesses. It is one of the computer applications that may be used for design and engineering that is utilised the most. Because of its comprehensive feature set and high level of functionality, SOLIDWORKS is used in a wide range of professions and industries all over the globe ("SolidWorks 2000," 2000)SOLIDWORKS makes use of parametric design, which is one of the reasons why designers and engineers find it to be such a beneficial tool in their work. As a consequence of this, the designer is able to understand how modifying a single component might have an effect on its neighbours or even the whole solution. If the size of a single component is raised, this will have an effect on the joint or hole that it is now affixed to. Because of this, designers are able to quickly detect and resolve any difficulties that may arise.

Figure 12 Solidworks logo (“SolidWorks 2000,” 2000)

SolidWorks is a piece of modelling software developed by Trash trapping combsoft and first made available in 1995. With more than two million users throughout the globe, Today is among the most widely used software applications in its field.The text-based SolidWorks logo has an appearance that is simple and airy, while yet being very contemporary and attractive. The logo is made up of a wordmark and an emblem that is placed to the left of it. Its palette consists of just one colour, and it employs three distinct fonts.The nameplate for SolidWorks, written in full capital letters, is visually separated into two parts: a strong and contemporary font for "Solid" with smooth "S" and opening "D" and thin lines of "Works", which makes the logo lighter and more lively (SolidWorks Logo and Symbol, Meaning, History, PNG, 2023).

The abstract mark that represents SolidWorks is made up of three curved lines that come together to create the "3DS" symbol. The symbol, which was designed by hand using clean, smooth lines, resembles a hieroglyph and is a complex and well detailed emblem.The colour red, which is used in the visual identity of SolidWorks, symbolises the software's progressiveness and vigour, as well as its growth and movement in step with the most recent technological advances(SolidWorks Logo and Symbol, Meaning, History, PNG, 2023)

The SolidWorks logo is simple and unobtrusive, but due to the varying widths of its lines, which are arranged in a way that is both harmonious and distinctive, it is instantly recognisable (SolidWorks Logo and Symbol, Meaning, History, PNG, 2023).

Figure 13 Meaning of Solidworks logo (SolidWorks Logo and Symbol, Meaning, History, PNG, 2023).

2.6.2 SOLIDWORKS ASSEMBLY

An assembly is a group of connected pieces that are kept together in a single SOLIDWORKS document file that has the extension.sldasm.Assemblies Contain ranging from two to over one thousand components, which may either be individual parts or additional assemblies referred to as subassemblies and Show movement between connected elements within the degrees of freedom they have available, together with Assembly mates are what are used to specify the relationships between the many components that make up an assembly. The process of attaching the components of the assembly utilising a variety of different kinds of mates, including coincident, concentric, and distance mates. The spigot subassembly is formed when the components are joined together. It is capable of generating assemblies via the use of two fundamental approaches: bottom-up design and top-down design.A blend of the two approaches being used. The goal of mating the components in order to generate the assembly or subassembly is the same regardless of whatever approach is used.The work in the assembly is when the top-down design methodology begins. It is able to make use of the geometry of one component in order to help define other parts, in order to produce features that influence several parts, or in order to build machined features that are added only after the parts have been joined. For instance, it may begin with a lathis projectt drawing or the determination of fixed component placements, and then it might proceed to design the parts by referencing these definitions.

In-context design is another name for the top-down design approach.For instance, it may place a component in an assembly and then construct a fixture depending on the part based on which it was placed.Working from the top down and constructing the fixture inside its context not only enables the reference of model geometry but also enables more control over the fixture's dimensions via the creation of geometric relations to the original component. In this manner, if a dimension of the component has to be adjusted, the fixture may be instantly updated.

Mates are used to precisely place the individual components of an assembly with regard to one another.The arrangement of the components determines how they may be moved and rotated in relation to one another.Mates provide new geometric relations, such as coincident, perpendicular, and tangent angles and lines. Each mate is valid for a distinct combination of geometry, including but not limited to cones, cylinders, planes, and extrusions. When this project are putting up an assembly, this project should begin with the component that does not move in relation to the other components. This is the component that will be fixed or anchored to the assembly's starting point.

Figure 14 Example of solidworks assemble. ("SolidWorks Animator," 1999).

Assembly mates are what are utilised to describe the relationship between the many components that make up an assembly. A variety of mates, including as coincident, concentric, and distance mates, are used in the process of connecting the individual components that make up the assembly. For instance, concentric and coincident mates are used in the process of connecting the components of the faucet handle and the faucet base. The spigot sub assembly is constructed with components that are a perfect complement for one another. After that, include this sub assembly into the main vanity assembly by mating it to the various components that make up the vanity.

Mates are used to ensure that the components of an assembly are exactly aligned with one another.How the components move and rotate in respect to one another is determined by their positions relative to one another("SolidWorks Animator," 1999).Mates are responsible for the creation of geometric connections such as coincident, perpendicular, and tangent angles. Each mate is only appropriate for a limited set of geometric pairings, which may include extrusions, planes, cones, and cylinders. Acceptable kinds of mates include coincident, concentric, and distance. These mates are used when mating one cone to another cone("SolidWorks Animator," 1999)

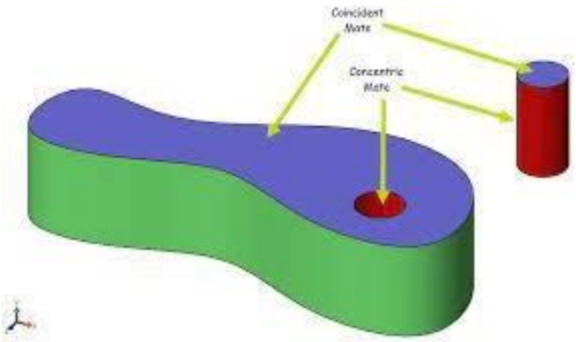


Figure 15 Coincident mate solidworks assembly ("SolidWorks Animator," 1999).

2.6.3 SOLIDWORKS DRAWING VIEW

There are two separate things to consider when talking about drawing templates and sheet formats. The package includes one drawing template as well as a collection of other sheet formats, both in English and metric. When a new drawing is started using the default drawing template, the dimensions of the painting cannot be predetermined.The piece of software asks this project to choose a format for the sheet. The drawing sheet's size, the drawing's borders and title block, as well as the sheet's scale, are determined by the format of the sheet.It is necessary to open a drawing template before beginning work on the drawing document. The most fundamental aspects of the document are included in the drawing templates. This project have the option to use either the default drawing sheets that are included with the SOLIDWORKS programme or to use templates that have already been customised. It is able to generate individualised drawing templates with any of the following attributes, such as Company name and logo, author's name, and other information; Drawing sheet size (for example, A, B, and C); Drawing standard (for example, ISO and ANSI); Units (for example, millimetres and inches); and Drawing sheet size (Papulov, 2019).

It would be suitable to use a drawing template for the vanity drawings that had a drawing sheet in the size and orientation of a letter C. Borders and title blocks are included in the standard drawing sheet formats for the C-size landscape format, which are as follows:
There are three separate pages included in the design document for the vanity. It is possible for a drawing document, often known as a collection of drawings, to include any number of drawing sheets. It is able to add sheets whenever necessary and in any format, independent of

the format that is being used for the sheets that are already present in the document.
At the very bottom of the graphics area are tabs labelled with the names of the sheets (Papulov, 2019).

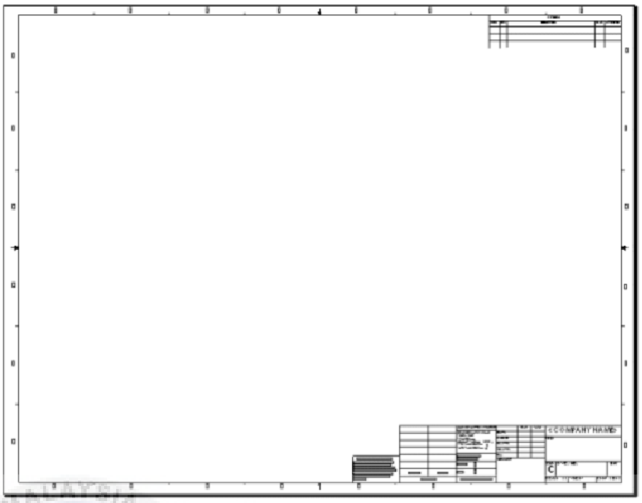


Figure 16 Solidwork drawing template (Papulov, 2019).

The title block may be found in the lower right hand corner of the sheet format by default.The title block looks like this after the sheet scale was adjusted, two more sheets were added, and the existing notes were edited and added. Both the scale and the page numbers are related to system variables and are automatically updated when those variables change.The sheet format serves as a foundation for the drawing sheet but is distinct from the drawing sheet itself. This project will need to alter the format of the sheet independently of the drawing sheet. Lines, note text, bitmaps, and the bill of materials anchor point are some of the elements that may be included in sheet formats. This project have the option of linking the notes to either the system attributes or the user properties (“Solidworks 2019,” 2018).

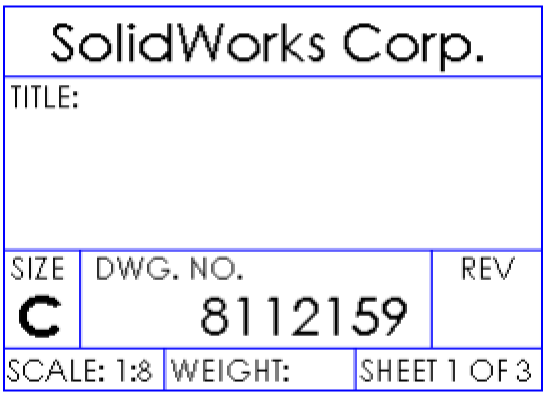


Figure 17 Sheet Formats (“Solidworks 2019,” 2018).

The photos of the models, together with their measurements and any comments, are drawn into drawing sheets, which also include the drawing views.Drawings begin with typical perspectives. It is possible to generate other sorts of views, such as projected, sectional, and detail views, based on these views.The front view, the top view, and the right view, sometimes known as the third angle projection, make up the standard 3 views.

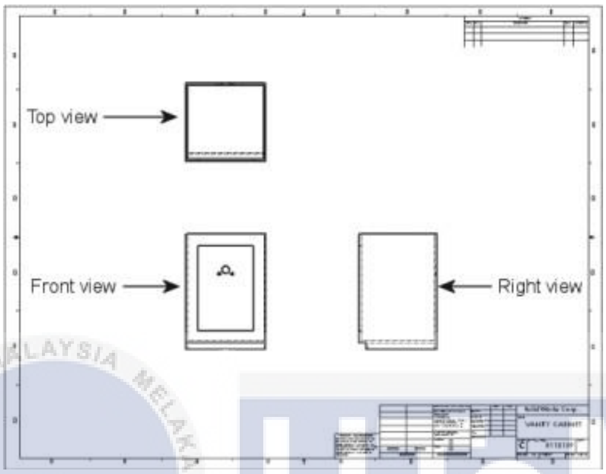


Figure 18 Three type of view (“Solidworks 2019,” 2018).

Alternatively, the front, the top, and the left (first angle projection) (first angle projection). When seen in third-angle projection, the front view is located in the bottom-left corner by default. When seen from the first perspective, the front view is presented in the top left corner of the image. The first-angle projection is a method that is often used throughout Europe. The projection of images at a third-angle is one that is often used in the United States. The example in this section makes use of the third-angle projection (RHODES, 1964).

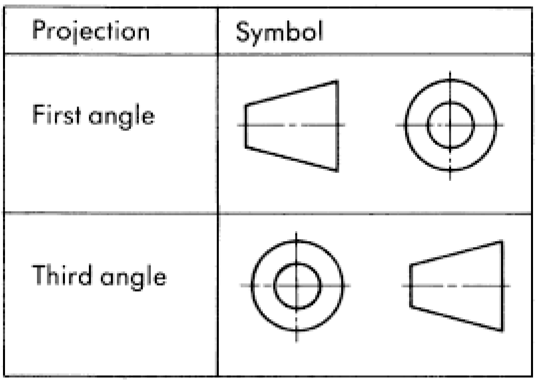


Figure 19 Angle of projection and symbol (RHODES, 1964).

The beginning of a drawing will often begin with a basic three view or another form of designated view, such as front, top, isometric, or exploded. These views may be imported from an open part or assembly document, from a file, or from other views included within the same drawing document.The term "standard 3 views" refers to a set of three different perspectives, which may be either front, top, and right (referred to as the third angle projection) or front, top, and left (referred to as the first angle projection). When using the third angle projection, the front view will appear in the bottom left corner by default. When seen from the first perspective, the front view is presented to the top left of the image. The first angle projection is the one that is most often used in Europe. Third

In most cases, drawings will employ an angle projection when done in the United States. This section includes an example that makes use of the third-angle projection.
The model papers include the names of the views. The following are examples of named views:

- Standard orientations, such as front, top, and isometric views
- Current model view
- Views with user-defined monikers

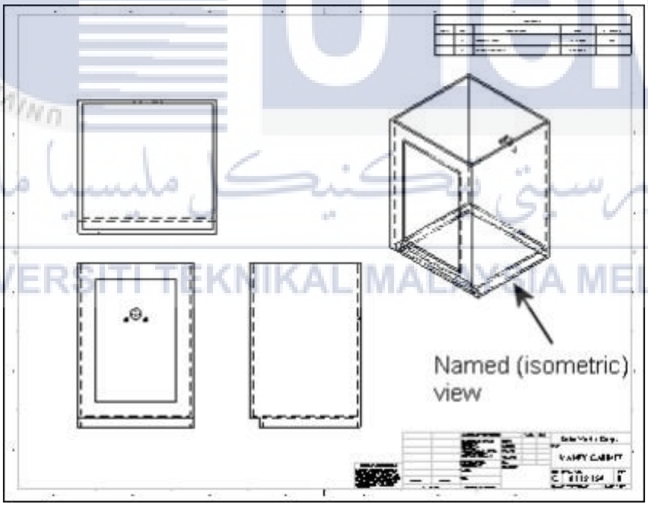


Figure 20Solidwork drawing isometric view *(RHODES, 1964).*

The model is connected to the dimensions that are included in a SOLIDWORKS drawing. The drawing is updated whenever there is a change made to the model, and vice versa. In most cases, this project will build dimensions as this project develop each feature of a component, and then insert those measurements into the drawing views after they have been created. Altering a dimension in the model will result in an updated drawing; conversely, altering a drawing dimension will result in the model being updated.

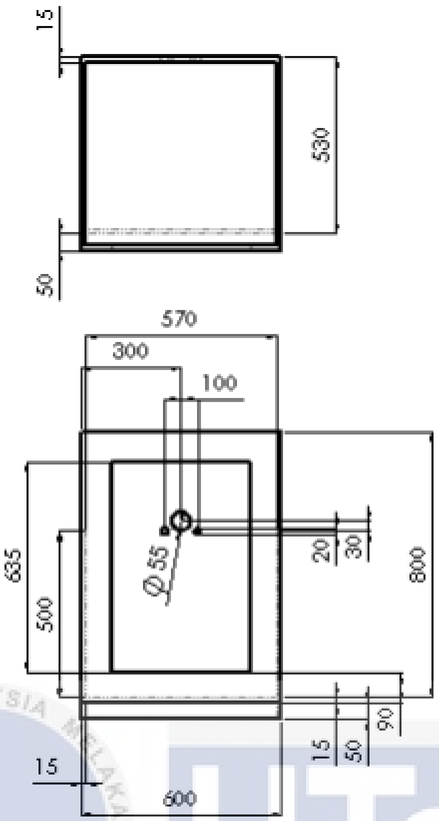


Figure 21 example of insert model item (RHODES, 1964).

This project may also put dimensions in the drawing document, but these will be reference dimensions that are driven by the model. This project won't be able to modify the model by editing the value of the reference dimensions.When there is a change in the dimensions of the model, there is also a change in the values of the reference dimensions.

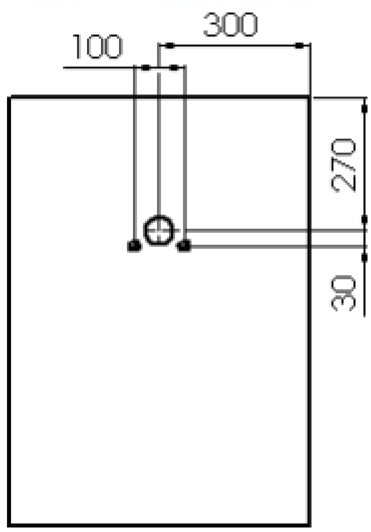


Figure 22 exampe of reference dimention (RHODES, 1964).

In the detailed settings, this project have the ability to choose the units (for instance, millimetres or inches) as well as the drawing standard (for instance, ISO or ANSI). According to the ISO standard, the vanity is measured in millimetres.In order to incorporate measurements from an existing model into the cabinet design in a quick and easy manner, this project make use of the incorporate Model Items tool. Insert items for a particular feature, an assembly component, a drawing view, or all views in the current document.When dimensions and annotations are introduced into all views, like in the example, they display in the view that is most suited for them.The features that can only be seen in partial views, such as section or detail views, are the ones that have their dimensions determined initially.After the dimensions have been inserted, this project are free to alter them. This project have a number of options available to this project, such as dragging them into place, dragging them to different views, hiding them, or editing their attributes.

In the event that the model includes annotations, this project are able to include such notes into the drawings by following the same process.On the Vanity Cabinet sheet, the rear view has been given so that this project can see the size of the holes that have been cut into the cabinet for the supply and waste pipes.This project can find the holes with the aid of the reference dimensions. This project have the option to choose whether or not the brackets will be automatically placed around reference measurements.

There are also things called baseline dimensions and ordinate dimensions, both of which are forms of reference dimensions. For instance, this project might add ordinate measurements to the front image of the cabinet in the manner that is shown here. This project have the option of dimensioning to arcs, edges, and vertices. In order to prevent overlapping, the dimensions are adjusted automatically. This project have the option of displaying ordinate dimensions without the chain, which consists of arrows that connect the dimension extension lines.There are also things called baseline dimensions and ordinate dimensions, both of which are forms of reference dimensions. For instance, this project might add ordinate measurements to the front image of the cabinet in the manner that is shown here. This project have the option of dimensioning to arcs, edges, and vertices. In order to prevent overlapping, the dimensions are adjusted automatically. This project have the option of displaying ordinate dimensions without the chain, which consists of arrows that connect the dimension extension lines.

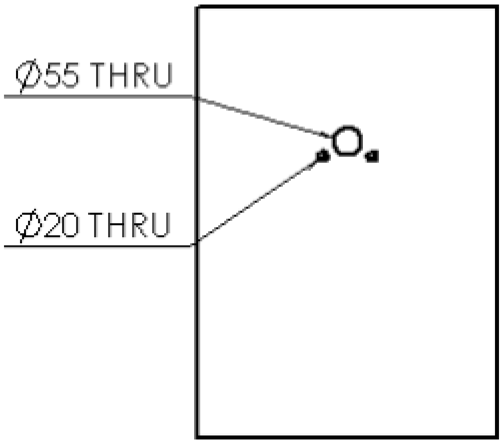


Figure 23 Example of hole callout (RHODES, 1964).

2.6.4 SOLIDWORKS SIMULATION AND ANALYSIS

The term "design" refers to the whole process, beginning with the conception and ending with the realisation of the idea.The process of creating new items and making changes to existing ones is known as design. Designers spent a lot of time and effort trying to find methods to describe and evaluate three-dimensional ideas without having to make physical models. The development of three-dimensional models on a computer provides a broad variety of advantages due to the progress that has been made in the field of computer technology. Computer models are simpler to comprehend and more amenable to modification. Computer models are capable of having simulations of real-life stresses placed on them, and the results may be visually shown.

The acronym FEA stands for finite element analysis, which is a numerical approach for addressing engineering issues by modelling actual-life operating conditions on a computer. issues such as structural analysis, heat transfer, fluid flow, soil mechanics, acoustics, and electromagnetism are examples of the types of issues that may be handled using finite element analysis. Assault Systèmes (DS) is the company that produced SolidWorks, which is a bundled collection of computer-aided engineering software tools for mechanical design. SolidWorks is a suite of programmes that may be used to allow a concurrent engineering approach to the design, analysis, and manufacture of mechanical engineering products. One of the programmes included in the suite is called the Finite Element Analysis module (SolidWorks Simulation), and it is part of SolidWorks. The fundamentals of structural analysis are the primary subject of this work, which makes use of the integrated SolidWorks and SolidWorks Simulation software (Introduction to Finite Element Analysis Using SolidWorks Simulation 2014, n.d.).

Procedures for finite element analysis emerged gradually as a result of the combined efforts of a large number of experts working in the domains of engineering, physics, and applied mathematics. The method of finite element analysis was first used to solve difficulties pertaining to stress analysis. During the 1940s, the fundamental concepts first made their appearance in published works. Hrenikoff made the hypothesis in 1941 that the elastic behaviour of a physically continuous plate would be comparable to the behaviour of a framework consisting of one-dimensional rods and beams that are joined together at discrete locations. After then, the issue might be solved by using conventional strategies for trusses and frames. An method to solve the torsion issue in elasticity was outlined in detail in a paper written by Courant in 1943. Courant elaborated on the application of piecewise linear polynomials throughout an area that has been triangulated. Since it was impracticable to solve the problem by hand, Courant's work was not recognised and quickly forgotten when it was completed (Introduction to Finite Element Analysis Using SolidWorks Simulation 2014, n.d.). The well-established "framework-analysis" approach was transformed by Argyris and Kelsey into matrix format in the early 1950s. This was done in response to the introduction of digital computers at that time. The year 1956 saw the development of stiffness matrices for truss elements, beam elements, and two-dimensional triangular and rectangular elements under plane stress by Turner, Clough, Matin, and Top.

In 1960, Clough was the one who coined the term "finite element" for the very first time. Following Melosh's discovery of a flat, rectangular-plate bending element in 1961, Grafton and Strome's creation of a curved-shell bending element in 1963 was the next significant step in the field. In 1961, Martin was the first person to create a three-dimensional element. In 1962, Gallagher, Padlog, and Bijlaard followed suit, and in 1964, Melosh did the same (Introduction to Finite Element Analysis Using SolidWorks Simulation 2014, n.d.).

Between the middle of the 1960s and the end of the 1970s, methodologies for finite element analysis moved outside the realm of structural analysis and into a wide variety of other disciplines of application. Large FEA software with a wide purpose started to become available. In the late 1980s, software for finite element analysis (FEA) became available for use on trash trapping combcomputers. This programme included automated mesh creation, interactive visuals, and the ability to preprocess and postprocess data.

In this book, we will follow a logical sequence, parallel to the historical development of the finite element analysis processes, in order to learn the basic ideas and commands for doing finite element analysis using SolidWorks and SolidWorks Simulation. This order will allow us to learn the essential concepts and commands in the most efficient and effective way possible. The one-dimensional truss element and the beam element will serve as our jumping off point as we go towards the more complex capabilities of SolidWorks Simulation. This paper also discusses the basic processes that must be followed in order to undertake two-dimensional and three-dimensional solid FE studies. The ideas and procedures that are detailed in this work may also be used with a variety of other FEA software programmes.

Throughout the course of the book, a wide variety of the traditional issues concerning the strength of materials and machine design are used as examples and exercises. It is hoped that this will assist the reader in developing more self-assurance when it comes to carrying out FEA analyses. (Introduction to Finite Element Analysis Using SolidWorks Simulation 2014, n.d.)

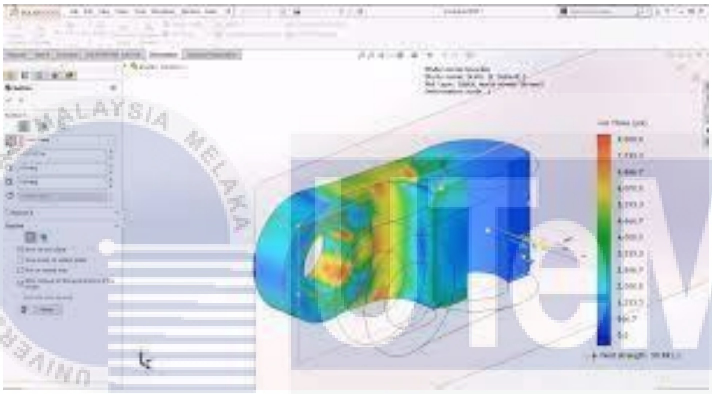


Figure 24 example of simulation and analysis (Introduction to Finite Element Analysis Using SolidWorks Simulation 2014, n.d.)

2.7 MIG WELDING

Gas metal arc welding, abbreviated as GMAW, is also known as MIG (metal inert gas) if the shielding gas is inert, like argon, or MAG (metal active gas) if the gas contains an active gas like carbon dioxide. MIG is the more common abbreviation. The method is often referred to as MIG/MAG welding or just MIG welding in Europe.

Even while it has traditionally been used most often for welding thin sheets, the method may be used to plates of a broad variety of thicknesses. This is because to the ease with which it may be started and stopped, which in turn contributes to its relatively high levels of production. When compared to stick electrode welding (MMA), MIG welding does not need as many frequent electrode changes or the removal of slag (Mig Welding Guide, n.d.).

To perform MIG welding, a metallic wire is run through the welding gun, and then melted in an arc. This is the fundamental concept of the technique. The wire fulfils two roles at once by serving as both the electrode that carries the current and the metal filling wire for the arc welder. A welding power source is what supplies the arc with the necessary amount of electrical energy for it to function. The arc and the pool of molten material are both shielded from harm by a gas that is either inert or active, depending on the situation. For the sake of this discussion, a gas is considered to be inert if it does not react with the molten substance.
Argon and helium are two examples of gases that fall into this group. On the other hand, active gases take part in the activities that take place inside the area and the molten substance. An example of an active gas is argon that has a trace amount of carbon dioxide or oxygen added to it.

It is essential to ensure that the welding parameters are accurately established in order to produce the best possible results from the welding process. The voltage, the speed at which the wire is fed, and the flow of the shielding gas are all examples of such parameters in MIG welding (Mig Welding Guide, n.d.).

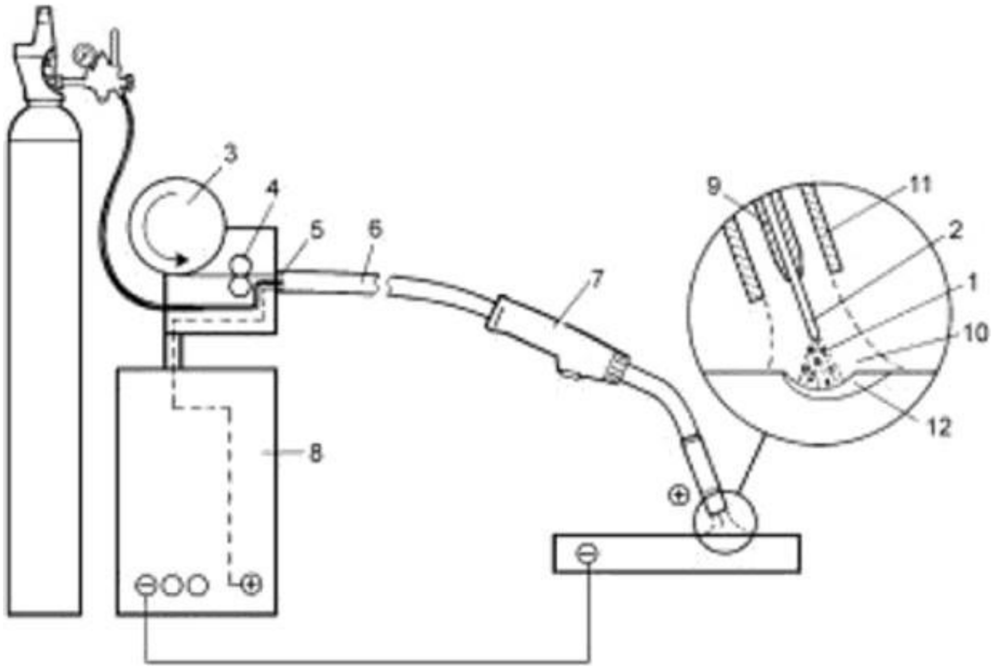


Figure 25 MIG welding (Mig Welding Guide, n.d.).

The basic idea of MIG welding is seen in figure 1.1. An arc is formed between the item of work and a wire that is constantly pushed forward in order to replace the metal that is melted away throughout the process. The wire is provided on a reel or a drum, and it is fed to the welding gun by drive rollers, which force the wire via a flexible conduit in the hose. The wire is then fed into the welding gun.to the rifle, the bundle. A welding power source is what provides the area with its supply of electrical energy. A contact tip located inside the welding gun is what transfers the welding current from the gun to the electrode. Typically, the workpiece is linked to the negative pole of the power source, and this contact tip is connected to the positive pole of the power source. The circuit is finished when the are is stricken.

The wire feeder moves at a pace of several metres per minute as it feeds the tiny diameter wire, which is normally approximately 1 millimetre in diameter. After that, the length of the are will automatically adapt itself according on the voltage setting of the constant potential power supply.

A shielding gas that protects the electrode, the area, and the weld pool from the impacts of the surrounding air flows via the shielding gas nozzle that surrounds the contact tip. This gas also protects the weld pool from contamination by the surrounding air. This shielding gas may either be inert, which indicates that it does not engage in the activities taking place in the weld pool, or it may be active, meaning that it does participate in those processes.

MIG welding is sometimes referred to as a semi-automatic process. This is due to the fact that the filler wire is fed through mechanically, but the movement of the welding gun over the workpiece is done manually. The procedure, on the other hand, lends itself well to being mechanised and automated, either by arranging for the workpiece to be moved or by automating the actions of the welding gun (*Mig Welding Guide*, n.d.).

Welding by robot has become an increasingly popular method of automating the welding process due to the ease with which the robot can be reconfigured to work with a variety of different items. In collaboration with the manipulator that is attached to the workpiece, the robot performs the welding movement. The automaton

Due to these benefits, the MIG process has been able to find a wide variety of applications, not only in large-scale manufacturing but also in more specialised, jobbing workshops. The automotive, shipbuilding, construction, and offshore oil and gas sectors are just few examples of the types of businesses that often use this strategy.

It's possible to say that learning and using the MIG approach is both straightforward and challenging. If the goal of the procedure is to simply join two pieces of sheet metal together without making any specific expectations about the quality of the final weld, then it may be considered a simple approach to utilise. On the other hand, if there are certain conditions to be met, such as thorough welding, full fusion, few pores, etc., then the MIG method demands the welder to have a significant amount of talent as well as experience.

In comparison to MMA, the MIG process utilises welding equipment that is more complicated, and as a result, more costly and less portable. This is one of the method's drawbacks. Because the shielding gas has to be kept from draughts, its deployment outside is likewise more restricted than it is inside. As a result of the design of the welding gun, there is a possibility that accessibility may be compromised in some welding scenarios (*Mig Welding Guide*, n.d.).

After the base metal, filler metal, and joint design have been defined, the welding factors should be chosen. The geometry of the weld bead is primarily affected by welding process variables such as penetration, bead reinforcement, bead width, and deposition rate, which is the weight of the metal deposited per unit of time. These variables are as follows: • Welding Current • Welding Voltage • Travel Speed • Wire Electrode Size • Type of Shielding Gas • Electrode Extension • Electrode Angle • Weld Joint Position (*Mig Welding Guide*, n.d.)

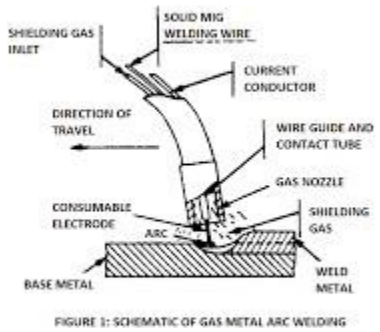


Figure 26MIG welding process (Mig Welding Guide, n.d.).

2.8 GRINDING

The term "grinding" refers to a group of different machining methods that use hard abrasive particles as the cutting medium. Grinding is the most frequent name for this group. Grinding is perhaps the oldest method of shaping materials still in use. It dates back to the period when ancient man discovered that he could sharpen his tools by rubbing them against rough rocks. It's possible that we would still be living in the Stone Age if we didn't have the capacity to crush stones into useful shapes and sharpen them.

In today's manufacturing world, grinding is a significant production process that accounts for around 20-25% of the overall expenditures made on machining operations in industrialised nations. Grinding is absolutely necessary for the functioning of society in its current form. The vast majority of the things that we make use of have either undergone some kind of machining process, such as grinding at some point during their creation, or have been processed by machines that owe their accuracy to abrasive processes. Without grinding, what other method do we have to sharpen cutting tools that will be used for turning, milling, and drilling (Grinding Technology, n.d.)

Figure 27 Hand Grinding Tool (Grinding Technology, n.d.)

How would we go about producing the rolling bearings that are used in machines and vehicles?How might we possibly make the components that go into disc drives for computers? The cutting tool that is used throughout the grinding process is what sets it apart from other machining techniques across the board. Small abrasive particles, also known as grains or grits, are often used in the construction of grinding wheels and tools. These particles are responsible for the cutting action, while a softer bonding agent is used to keep the countless grains of abrasive together in one solid mass. Natural sandstone, which has granules of sand embedded inside a silicate bond matrix, was the abrasive tool of choice for prehistoric man. The construction of contemporary grinding wheels entails using an appropriate bonding medium to bind together abrasive grains, which are often derived from man-made materials. Every grain of abrasive is essentially a little cutting instrument waiting to be used. During the grinding process, thousands of abrasive cutting points are used at the same time, and millions are utilised continuously (Grinding Technology, n.d.).

When it comes to the manufacturing of components that must have smooth surfaces and precise tolerances, grinding is often considered to be the very last step in the machining process.Grinding is the only method that can compare to it in terms of achieving the highest accuracy.Grinding is an essential step in the manufacturing process that ultimately results in a completed product (Grinding Technology, n.d.).

A grinding machine, sometimes referred to simply as a grinder, is a kind of industrial powered instrument that utilises an abrasive wheel to cut or remove material. When utilising this method to cut metal off the surface of the workpiece, an abrasive wheel that rotates in a circular motion is utilised. Grinding is a type of finishing that produces a surface that is of high quality, has an accurate form, and has accurate dimensions (Grinding Technology, n.d.).

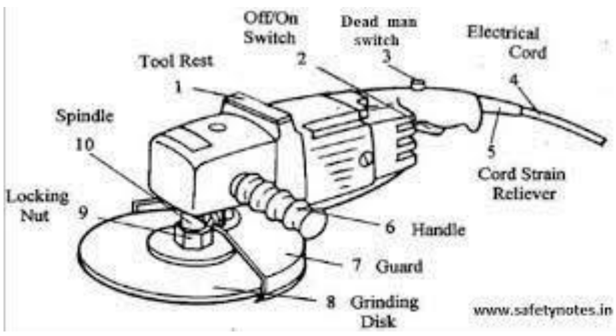


Figure 28 Grinding Machine (Grinding Technology, n.d.)

After turning on the tool, position the wheel or disc so that it is on top of the workpiece. In general, this project should maintain a 15-degree angle between the edge of the wheel or disc and the surface of the workpiece. To avoid the workpiece from being damaged while a fresh wheel is being broken in on the grinder, move the grinder in the forward direction.When the leading edge of the wheel has been worn down enough by usage, it may be rotated in either the forward or the reverse direction.

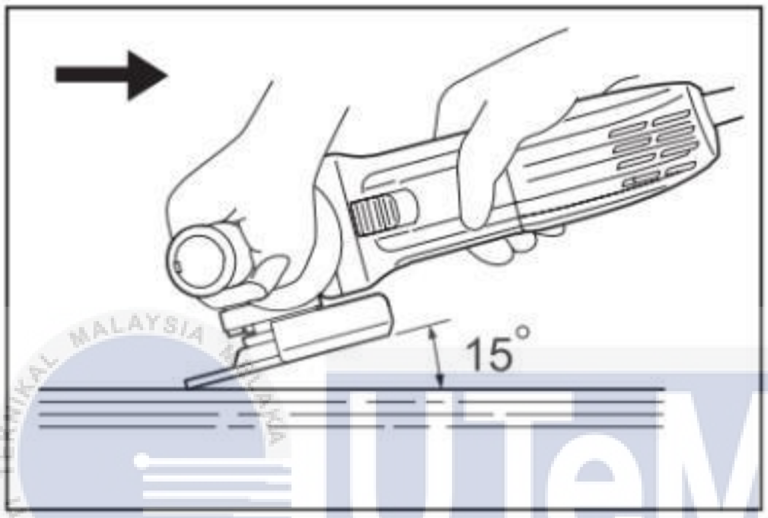


Figure 29 Angle between grinding process (Grinding Technology, n.d.)

When grinding, several different kinds of wheels and discs are used, each of which is developed for a certain set of tasks. The following are some examples of frequent types.Grinding Wheels That Are Straight Straight grinding wheels are the most common sort of grinding wheel, and they are used for grinding tasks that are more broad in nature. They have a profile that is flat, and the primary applications for them include sharpening tools and grinding surfaces.

Reinforced Grinding Wheels with a Depressed Centre Depressed centre grinding wheels, sometimes referred to as Type 27 wheels, include a reinforced wheel with a depressed centre. Because of the depression in the centre, grinding may be done at an angle. This feature is very helpful for grinding welds, blending surfaces, and removing heavy stock material (Li & Axinte, 2016).

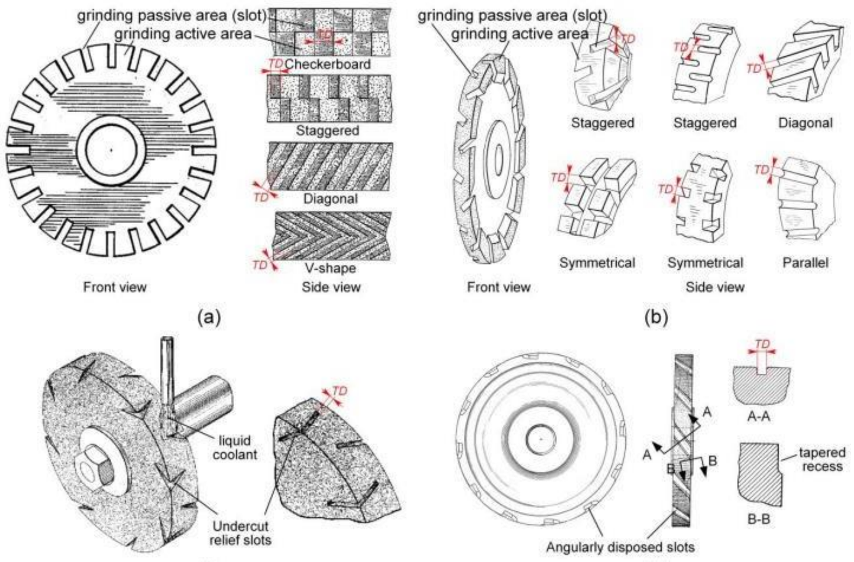


Figure 30View of grinding wheel (Li & Axinte, 2016).

Cut-Off Wheels: These are discs made of an abrasive substance that are thin and straight. They are used to cut a variety of materials, including concrete, ceramics, and metal. They were developed specifically for high-speed cutting and find widespread use in sectors such as construction and metal production (Li & Axinte, 2016).

Discs with Flaps: Discs with flaps are made up of abrasive flaps that overlap one another and are glued to a central hub. They have a wide range of applications and may be used in the processes of grinding, mixing, and finishing. The removal of burrs, the preparation of surfaces, and the grinding of welds are typical applications for flap discs (Spruce, 2016).

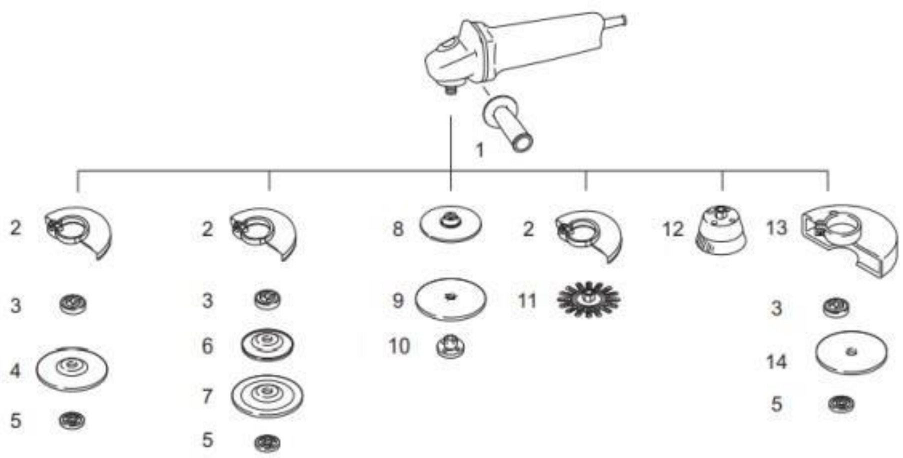


Figure 31Type of wheel and disc (Li & Axinte, 2016).

Diamond Grinding Wheels: These wheels employ synthetic diamonds as the abrasive material and are generally used for grinding hard and brittle materials such as carbides, ceramics, and glass. Diamonds are a naturally occurring component of diamonds. Diamond grinding wheels have a very fast production rate, in addition to exceptional accuracy and a very long lifespan (Spruce, 2016).

Even though they are not strictly wheels or discs, wire brushes are often used in grinding applications for a variety of purposes, including the removal of rust, the cleaning of surfaces, and the cleaning of welds. They are made up of bristles that are formed from wire composed of either steel or brass, as well as other materials.

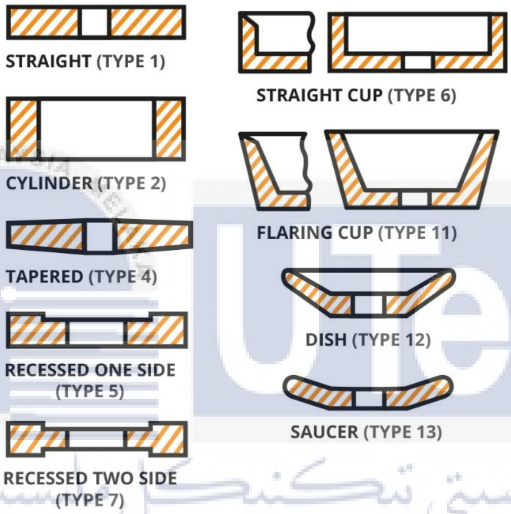


Figure 32 Type of wheel (Spruce, 2016).

These are just a few examples of the many different kinds of grinding wheels and discs that are available, each of which is intended for certain tasks and kinds of materials. The particular application, the material that is being worked on, and the results that are wanted all play a role in determining the kind of wheel or disc to use. In order to carry out grinding operations in a manner that is both effective and safe, it is necessary to use the suitable tool (IZAWA, 2005).

2.9 TYPE OF MATERIALS

Conveyor cleats, also known as belt cleats or conveyor belt cleats, are normally comprised of a variety of long-lasting materials that offer grip and stability to the conveyor belt. Other names for conveyor cleats are belt cleats and conveyor cleats. The exact use, the kind of conveyor belt, and the environment in which it will be utilised all have a role in determining the material that should be used.

2.9.1 RUBBER

Because of the exceptional qualities and benefits that it has, rubber is a very adaptable material that is often used for the production of conveyor studs. The following is an in-depth description of how rubber may be used as a material for conveyor studs.Grip and Traction for Rubber studs provide outstanding performance in each of these categories on the conveyor belt. Rubber has a natural tackiness that helps it to keep a tight grip on the surface of the belt. This prevents products from slipping off the belt and ensures that the conveyor moves quickly and efficiently.Flexibility and Conformability for Rubber naturally has a high degree of flexibility and can be moulded into the desired shape with relative ease. Because of this quality, the studs are able to keep their contact with the belt surface even while the belt is being bent or flexed, which guarantees that the performance will remain constant.Abrasion Resistance is related Rubber studs have a high resistance to abrasion, which indicates that they are able to survive the wear and tear that is brought on by the consistent rubbing and contact against the conveyor belt. This resilience results in an increased lifetime for the cleats, which in turn reduces the expenses associated with maintenance and replacement.

Impact Resistance Rubber has a high impact resistance, which means that studs made of rubber can bear large loads or rapid impacts without being deformed or losing their shape. Rubber also has strong abrasion resistance. This characteristic is very useful in fields where big or heavy goods need to be transported, such as manufacturing and construction.Chemical Resistance Rubber cleats have a high level of resistance to a wide variety of chemicals, oils, and solvents, which qualifies them for use in industries in which workers are often exposed to these types of contaminants. This resistance helps to keep the cleats from deteriorating or becoming weaker throughout the course of their use.

Rubber has intrinsic damping capabilities, which means it may absorb and minimise noise and vibrations created during the operation of the conveyor system. Because of these features, rubber can act as a noise and vibration dampener. The conveying procedure is made less noisy and more smooth thanks to the presence of this feature.Temperature Range Rubber studs, depending on the exact kind of rubber that was used, are able to tolerate a broad temperature range, ranging from low temperatures to high temperatures. Because of its adaptability, rubber cleats may be used in a wide variety of settings and business sectors.Rubber studs are versatile and may be readily adapted to suit the needs of a variety of applications because to their adaptability. They are able to be moulded into a variety of forms, sizes, and profiles, which allows the performance of the conveyor system to be optimised while also allowing them to adapt to a variety of material handling requirements.

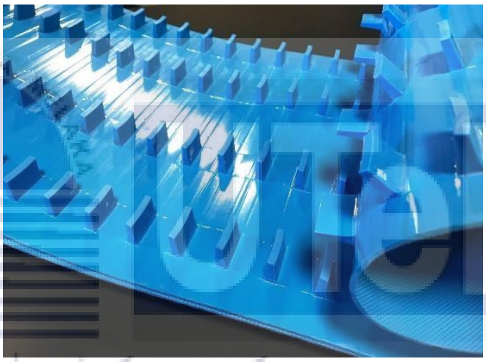


Figure 33(Conveyor Rubber Belt Cleats, 2018)

2.9.2 PVC

PVC, also known as polyvinyl chloride, is a kind of synthetic plastic that, because to the exceptional qualities it has, is often used for the production of conveyor studs. A more in-depth description of the use of PVC as a material for conveyor studs is as follows:PVC is a lightweight material, which makes it simple to work with and install since it requires less effort. This quality is useful for conveyor systems, which, in order to function well, need a lower overall weight.PVC cleats have a considerable degree of flexibility, which enables them to adjust to the contours of the conveyor belt. Flexibility is a benefit. Even when the belt is bent or flexed, the studs are able to keep their contact with the surface of the belt because to the flexibility of the material.

This allows for efficient conveyance of the material.Chemical Resistance PVC cleats have a strong chemical resistance, which qualifies them for use in applications that often put them in contact with a variety of chemicals, oils, or solvents. This resilience helps prevent the cleats from being degraded or weakened when they are exposed to pollutants of this kind.

PVC is a sanitary material that does not harbour bacteria and is simple to clean and maintain. PVC cleats are excellent for use in sectors such as food processing and pharmaceuticals, as well as other applications that need high cleanliness requirements since they are resistant to moisture and do not encourage the development of germs.PVC is a cost-effective choice for conveyor studs since it is less costly than some of the other materials that are employed. Cleats made of PVC are a popular option due to their low cost, which makes them particularly useful for businesses who need to purchase big numbers of cleats.Insulation from Electricity PVC has strong electrical insulation qualities, which may be helpful in situations where the amount of electrical conductivity that must be minimised is critical. Static electricity may be prevented from building up with the use of PVC cleats, which in turn reduces the likelihood of sparks or other harm to sensitive electronic equipment.Temperatures in the Moderate Range PVC cleats can normally resist temperatures in the moderate range, which qualifies them for use in conveyor systems that function in temperatures that are either at or slightly above room temperature. PVC could, however, have certain drawbacks when it comes to applications that involve very high temperatures.

PVC cleats provide a high degree of versatility since they can be readily moulded into a wide variety of forms, sizes, and profiles to meet the needs of a particular application. They may be altered to offer the required height, spacing, and pattern for efficient material handling. This is possible because to their adaptability.PVC cleats may have limits in terms of temperature resistance and mechanical strength when compared to cleats made of other materials such as rubber or urethane. It is vital to be aware of these potential limitations. As a result, it is very necessary to take into account the particular requirements of the application and to confer with the cleat manufacturer in order to guarantee that PVC cleats are appropriate for the application in question.

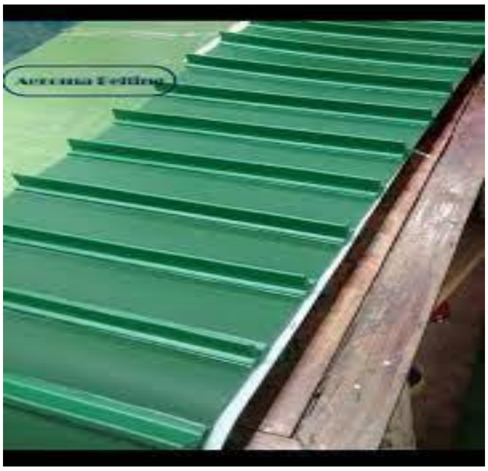


Figure 34(SIDEWALL CLEAT BELT CONVEYOR – Truck Loader Conveyor, Truck Loading Conveyor, n.d.)

2.9.3 METAL (STAINLESS-STEEL)

Conveyor studs are often made of metal since it is a durable material that can withstand high temperatures and also performs well in situations that need for heavy-duty performance. The following is an in-depth description of how metal functions as a material for conveyor studs:Metal studs, which are often comprised of stainless steel or other alloys, provide great levels of both strength and longevity due to their composition. They are resilient enough to bear significant loads, impacts, and mechanical stress without being deformed or losing their shape. Metal studs are an excellent choice for use in heavy-duty situations that call for studs that are both sturdy and durable.Resistance to High Temperature Metal studs perform very well in high-temperature situations, but studs made of other materials may decay or fail under these conditions. For instance, stainless steel can resist high temperatures without suffering any damage to its overall composition or compositional integrity. As a result of this quality, metal studs are well-suited for use in sectors such as foundries, steel mills and the production of glass, where they can transmit hot materials without sustaining damage.

Chemical Resistance Metal studs have a high level of resistance to a broad variety of chemicals, including corrosive compounds, acids, and solvents. Because of their resilience, the cleats are able to keep their structural integrity and continue to operate well even in conditions that are highly reactive to chemicals.Hygiene and Ease of Cleanliness Because metal studs are so simple to disinfect and keep in good condition, they are an excellent choice for businesses that must adhere to high cleanliness and hygiene standards, such as those involved in the food processing or pharmaceutical sectors. Because it does not have pores and is not conducive to the formation of germs, stainless steel in particular provides excellent sanitation.Electrical

Conductivity Cleats made of metal have a higher electrical conductivity than those made of other materials, which might be an asset in situations when static electricity has to be eliminated. Because of its conductivity, the conveyor belt helps to avoid the accumulation of static charges, which in turn reduces the likelihood of sparks or other damage to sensitive electronic equipment.Personalization It is possible to tailor metal studs to the requirements of a particular application. They are able to be built in a variety of sizes, shapes, and profiles, which enables exact adaption to a variety of conveyor systems and the varied demands placed on the material handling process.

Compatibility with Magnetic Systems: Some metals, including stainless steel, have a natural magnetic property that makes them compatible with magnetic systems. Due to the presence of this feature, metal studs may be made compatible with magnetic conveyor systems. These systems employ magnets to separate products or move them.It is essential to be aware that metal studs could be much heavier in comparison to other types of materials, and that this might result in an increase in the amount of noise or wear on the conveyor belt. When choosing metal studs, appropriate attention should be given to the individual application requirements, the kind of belt, and the possible influence on the conveyor system.

Figure 35 (Hinged Belt Conveyors, n.d.)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The procedures that are followed in order to carry out an analysis are referred to as the methodology. It is a method for accomplishing goals by means of planning, data gathering, research, and analysis in order to provide evidence that the study may be trusted. Because of the strategy, the study will become more systematic, and the scientific approach will become more focused and effective as a consequence of the approach. The complete procedure will be detailed in this paper, beginning with the gathering of field data and continuing all the way through the examination of the collected samples.

3.2 PROJECT PLANNING

3.2.1 RESEARCH METHOD

Along the Malacca River is where all of the parameter sample data that is required for this research will be collected for this investigation. The HYDROQS Detachable Mini Portable Conveyor is designed with the intention of being equivalent to conventional techniques, which require a great deal of time and do not provide real-time results Data.

3.2.2 RESEARCH AREA

This research will be carried out at the Malacca River in conjunction with the Perbadanan Pembangunan Sungai dan Pantai Melaka in order to monitor and lessen the amount of garbage that is found in the river.(PPSPM). This apparatus, which has been constructed, will be placed on the boat, and it will go along the Malacca River in order to collect the garbage that is submerged in the water.

3.2.3 FLOW CHART

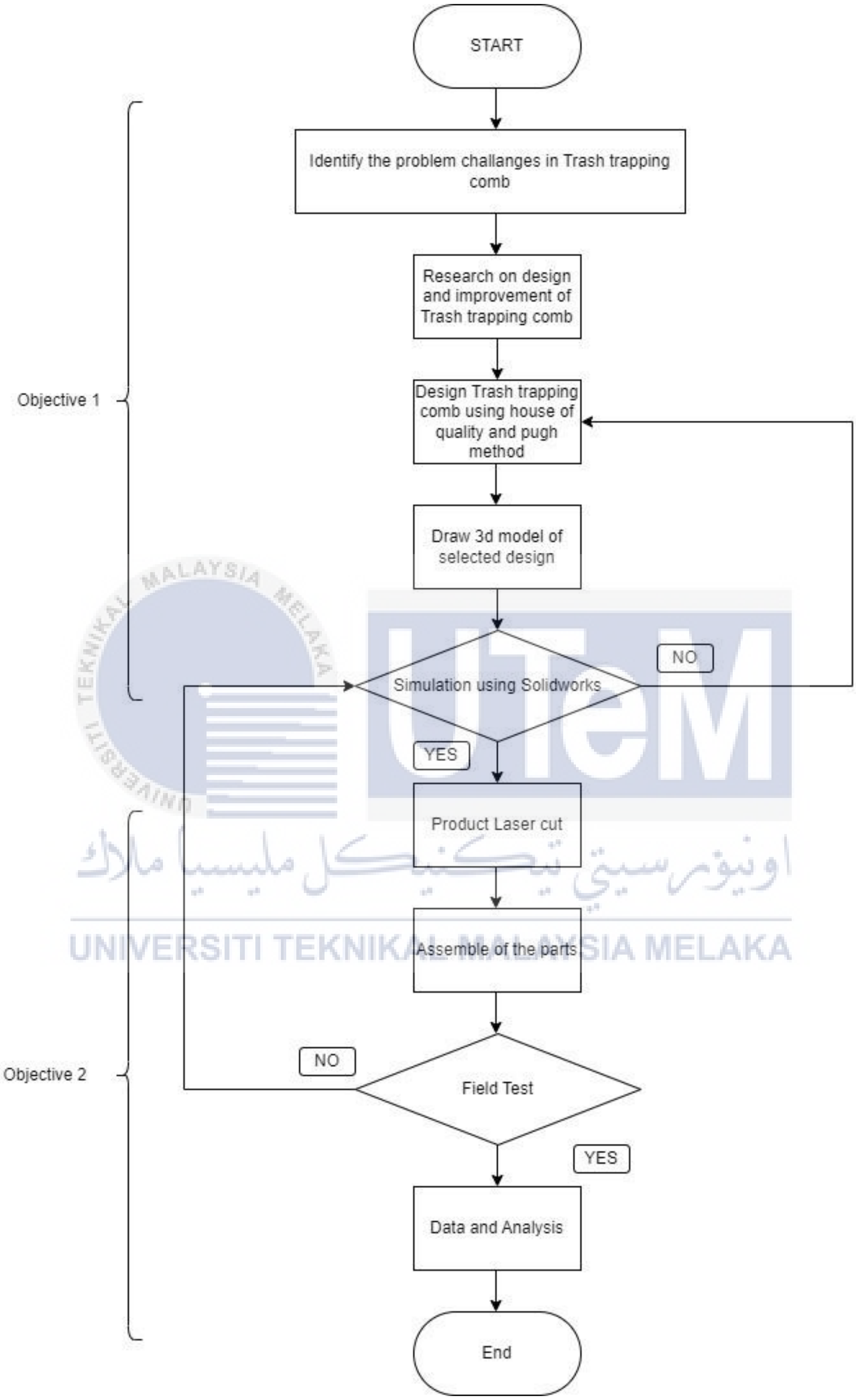


Figure 36 Flow Chart

3.2.4 HOUSE OF QUALITY

House of Quality (HOQ) is an item arranging grid that exhibits how trash trapping comb meet those requirements. The following figure showed the House of Quality (HoQ) for the Portable Trash trapping combscope. Several criteria have been considered for this trash trapping comb to develope in their needs. As a result, the House of Quality method can be used to analyse it.

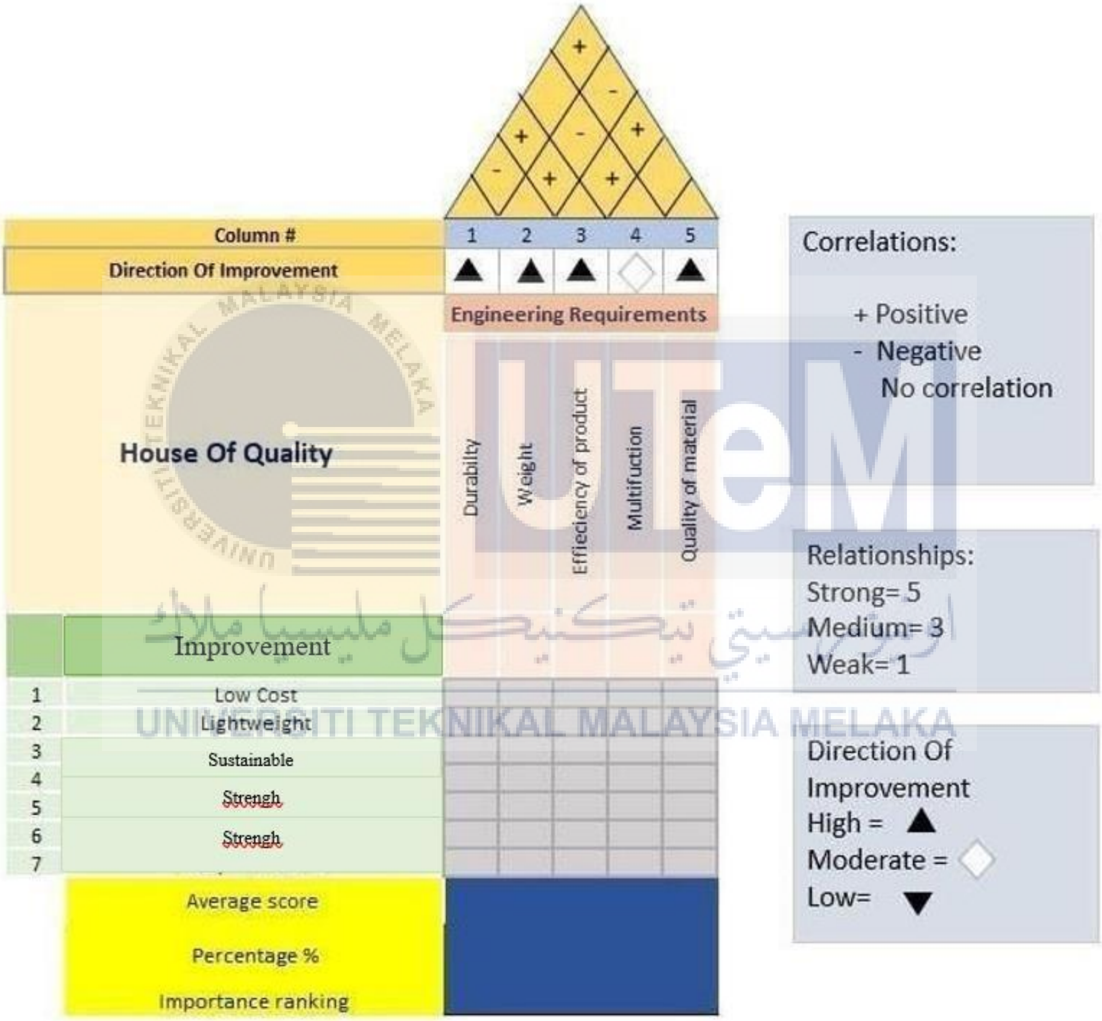


Figure 37 House of Quality for Trash Trapping Comb

3.3 TRASH TRAPPING COMB

A Trash trapping comb is a specialized component or attachment that is attached to the conveyor belt in a conveyor system. Trash trapping combs are also referred to as cleat. Trash trapping combs are used in order to regulate the movement of things being carried on the belt as well as their location. They are often constructed from long-lasting materials such as metal, plastic, or rubber, and are built in a variety of forms and sizes, depending on the particular use they are intended for.

The main purpose of Trash trapping combs is to stop the material that is being conveyed from sliding down the conveyor belt or falling off of it altogether. They give stability and make certain that the things continue to stay firmly in place while being transported from one location to another. When working with inclined or steeply inclined conveyors, where gravity alone may not be enough to keep the material on the belt, studs are very beneficial since they help keep the material in place (Hrabovský & Fries, 2021).

Figure 38 Trapping comb attached with conveyor (Hrabovský & Fries, 2021).

Trash trapping combs are installed at key locations along the length of the conveyor belt, and their precise placement depends on the composition of the material being moved and the kind of conveying operation that is needed. They may be adhered to the surface of the belt using a variety of techniques, such as vulcanization, mechanical fasteners, or adhesive bonding, for example.

The precise needs of the material being delivered are taken into consideration while designing Trash trapping combs, including their form and height. The V-shape, the rectangle, and the chevron pattern are all common configurations for Trash trapping combs. The design of the Trash trapping comb that is used is determined by a number of parameters, including the flow properties of the material, its size, its weight, and the degree of inclination. For instance, studs in the form of a V are often used for the manipulation of solid or granular materials, whilst studs in the shape of a chevron are appropriate for the manipulation of bulkier or more irregularly shaped things (Hrabovský & Fries, 2021).

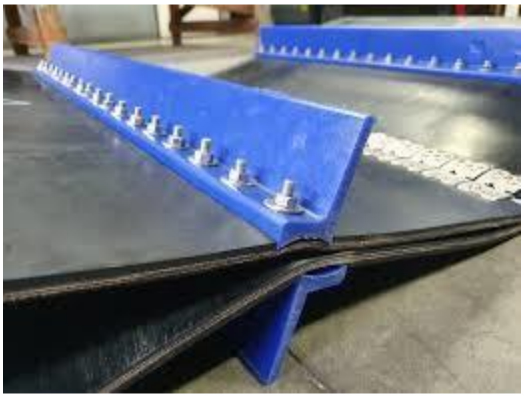


Figure 39 Example of trapping comb known as cleat (Hrabovský & Fries, 2021).

Trash trapping combs may also be modified to meet the requirements of certain applications. For instance, Trash trapping combs used in the food sector may be constructed from food-grade materials that are in accordance with the requirements for cleanliness. Trash trapping combs used in industries that deal with significant weights need to be able to endure harsh conditions such as high temperatures, abrasive materials, and loads.

Trash trapping combs are an essential component of conveyor systems because of the significant impact they have on the functioning, safety, and productivity of the material handling operations. They provide seamless operations across a broad variety of industries and applications by providing dependable transportation and preventing product loss (Hrabovský & Fries, 2021).

3.3.1 TYPE OF CLEAT

Conveyor systems make use of a wide variety of cleats, each of which is tailored to meet the requirements of a particular application and method of material handling. The following are some of the most prevalent kinds of cleats:

V-Shaped Cleats V-shaped cleats have a profile that is either triangular or trapezoidal and have an angle that faces inward. They are often put to use in the process of transporting bulk materials such as grains, sand, or things of a smaller size. A strong hold is provided by the V-shape, which also stops materials from slipping or rolling off the conveyor belt.

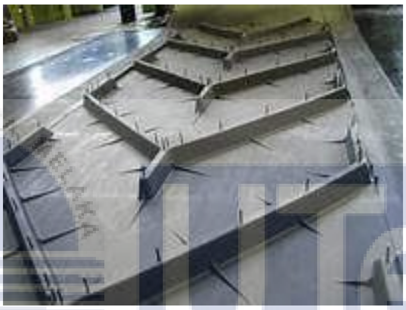


Figure 40 V-Shaped cleat (Gerritzen, Marien. (2015)

Cleats with a Rectangular design Rectangular cleats are flat and rectangular in design, and they provide a greater surface area for making contact with the material that is being carried. They are able to handle things that are bigger or heavier than normal, and they may be used for both inclined and horizontal conveyor systems.

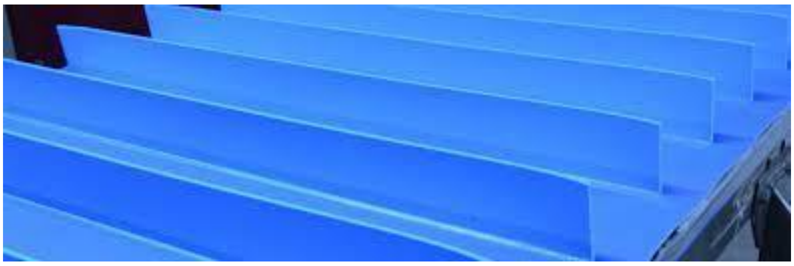


Figure 41 Rectangular cleat (Products - Conveyor Belts in PVC and PU - Cleats and Profiles - Stima Engineering Ltd., n.d.)

Chevron Cleats: Chevron cleats feature a zigzag or chevron design on the surface, which provides more grip and stability. Chevron cleats are a popular choice among soccer players. When moving bulk goods or products with uneven shapes, a cleat of this sort is extremely useful since it stops stuff from slipping or sliding.

Figure 42 Cherfron cleat (Chevron Cleated Conveyor Belt,Chevron Cleated Conveyor,Chevron Cleated Belt Suppliers, n.d.)

Bucket Cleats: Bucket cleats are a specialised kind of cleat that are often used in bucket elevators. They are able to scoop up things and move them in a vertical orientation because to their one-of-a-kind design, which takes the form of a pocket or a bucket. When working with granular or powdered materials, bucket studs are a tool that is often used in a variety of sectors, including agriculture, mining, and construction.

Magnetic Cleats Magnetic cleats are characterised by the incorporation of magnets into the cleat material. They find their most common use in magnetic conveyors, which are designed to transfer ferrous or magnetic materials. The magnetic force of the cleats contributes to safely moving the material down the conveyor belt while also helping to retain it in place.

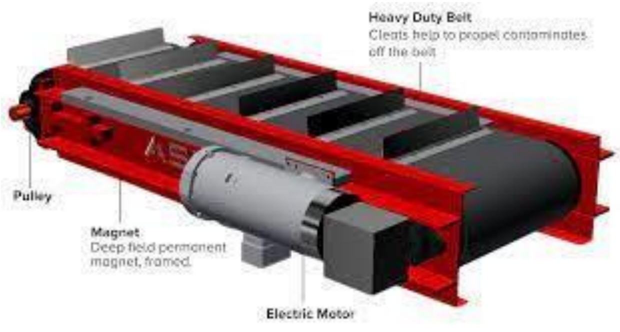


Figure 43 Magnetic Cleat (Magnetic Separator | Complete Conveyor Solutions | ASGCO | ASGCO, n.d.)

Cleats that Are Made From Food-Grade Materials In the food business, cleats may be specially constructed utilising food-grade materials that are meant to fulfil strict criteria for cleanliness and safety. These cleats are resistant to contamination and simple to clean, which ensures that they will comply with the standards that govern the preparation of food.

Cleats may also be modified to the user's specifications in order to fulfil a wide variety of needs. This includes differences in height, breadth, the nature of the material, and the techniques used to attach it. Standard cleats may not be ideal for certain specialised uses, thus instead, people may often utilise customised cleats instead.

Figure 44Type of cleat design S. (2015, October 14)

The kind of material that is being delivered, the inclination angle of the conveyor, the desired grip or traction that is needed, and any special industry laws or standards that must be satisfied all play a role in the selection of the suitable cleat type. It may be helpful to consult with the makers of the conveyor system or other specialists in order to identify which kind of cleat is best suited for a given application.The best solution for choosing the cleat or known as trash trapping comb is the custom made that represent rectangular cleat with some modification.

3.4 CONCEPT DESIGN

The earliest phase of the design process is known as the concept design phase. During this phase, ideas and concepts are developed and explored in an effort to uncover possible solutions to a problem or to satisfy a particular design goal. Before going on to the stages of comprehensive design and execution, there is a stage that is creative and experimental. During this stage, the emphasis is on developing and visualising various design options.

In the phase of concept design, designers engage in activities like as brainstorming, sketching, and the creation of prototypes in order to investigate a variety of different design options. The purpose of this exercise is to come up with a variety of concepts that may be analysed in terms of their practicability, utility, and aesthetics, as well as any other pertinent factors. At this stage, this project'll need artistic ingenuity, technical expertise, and the ability to think creatively about fixing problems.

3.4.1 CONCEPT DESIGN 1

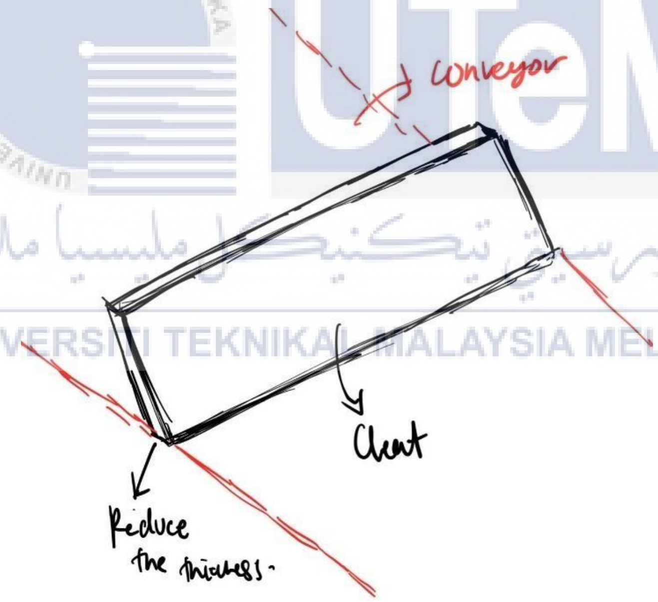


Figure 45 Concept design

Based on the figure, the details of conceptual design 1 was sketched.The design is big and strong.But it have a lot of diadvantages.This design based on Rectangular cleat.Eventhough its strong it can cause the system heavier.The output of collecting trash will be slow.The machine will be slower.

3.4.2 CONCEPT DESIGN 2

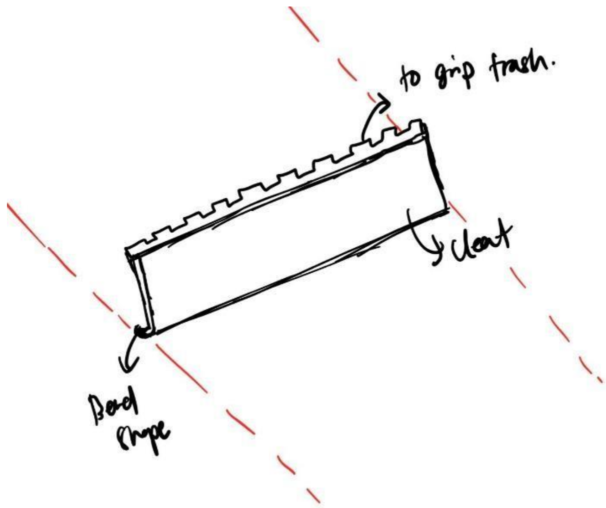


Figure 46 Concept design 2

Based on the figure, the details of conceptual design 2 was sketched.The design was modified in thickness.The thichness of the design was reduced. Depending on the particular application and the substance that is being transported, decreasing the thickness of the cleats that are used in a conveyor system may provide a number of benefits

3.4.3 CONCEPT DESIGN 3

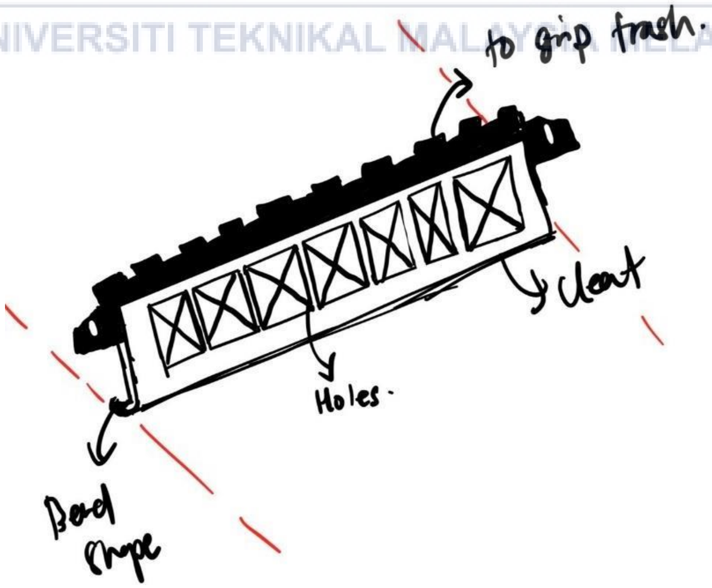
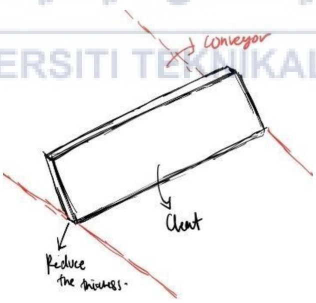
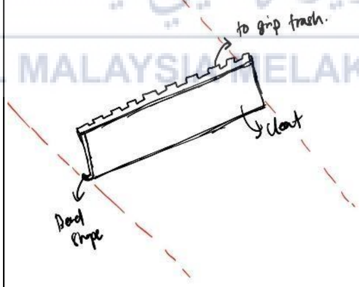
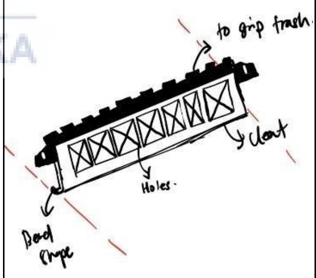


Figure 47 Concept design 3

Based on the figure, the details of conceptual design 3 was sketched.The design was modifed in top that attach comb to make cleat more grib to trash. Depending on the particular application and the substance that is being transported, decreasing the thickness and add comb in top of cleats that are used in a conveyor system may provide a number of benefits.

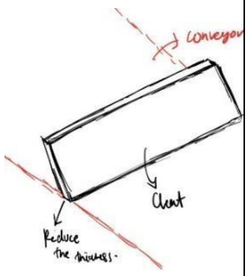
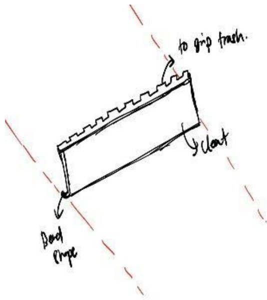
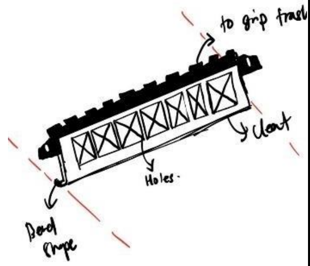
3.4.4 PUGH METHOD

The Pugh Matrix is a decision network that is based on rules that use scoring to determine which of many possible arrangements or alternatives should be selected. After receiving the results of the disseminated survey, this project may then proceed with this procedure. The findings of the poll will be used to choose the top three conceptual ideas and rate them based on how well they fit all of the criteria.One of the conceptual designs will be picked, and it will be the one that receives the highest score overall.

	OPTION		
CRITERIA	DESIGN A 	DESIGN B 	DESIGN C 
EFFICIENCY OF THE PRODCUT			
AFFORDABLE			
DURABLE			

THICKNESS			
LIGHTWEIGHT			
MULTIFUNCTION			
MAX LOAD			
MATERIAL			
TOTAL +			
TOTAL -			
TOTAL SCORE			

Table 1 The pugh method table

Weighted decision matrix							
		Options					
							
Criteria	Weighting	Design A		Design B		Design C	
		Score	Total	Score	Total	Score	Total
EFFICIENCY OFTHE PRODCUT	5						
AFFORDABLE	5						
DURABLE	5						
THICKNESS	5						
LIGHTWEIGHT	5						
MULTIFUNCTI ON	5						
MAX LOAD	5						
MATERIAL	5						

Total		Total		Total		Total	

Table 2: The weight decision matrix of trash trapping comb.

3.5 FINAL DESIGN OF TRASH TRAPPING COMB

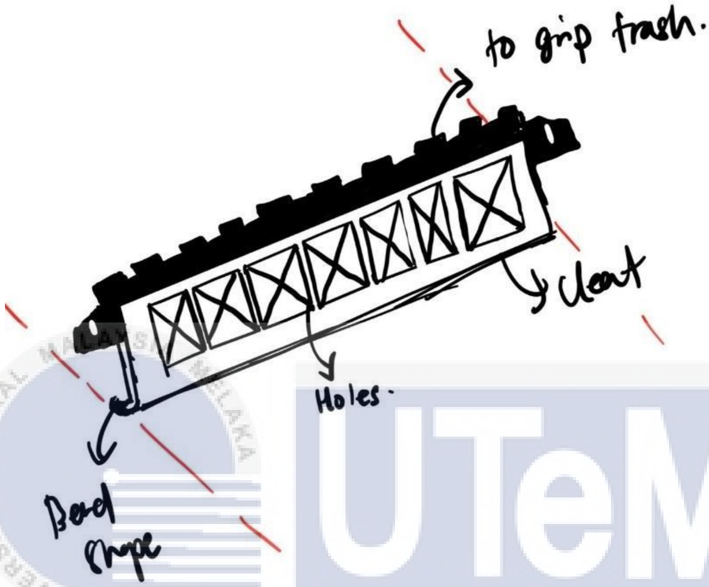


Figure 48 Final Design of Trash Trapping Comb

The advantages of reduce cleat thickness are Lower Conveyor Profile: Because thinner studs result in a decreased overall height of the conveyor belt, this feature might be helpful in circumstances in which space is restricted or while transporting items in locations with little clearance. Because of the conveyor system's smaller profile, it may be possible to make it more compact and simpler to incorporate into already existing manufacturing lines.

Flexibility Increased: The conveyor belt now has a higher degree of flexibility because to the thinner studs. This flexibility may be useful for transporting products with unusual shapes, as well as when negotiating bends and inclines along the path of the conveyor. It makes it possible for the belt to adapt to the curves of the conveyor system in a closer manner, which improves the system's overall efficiency and reduces the likelihood of material spillage.

Reduced Weight: Cleats that are thinner on average weigh less than those that are thicker, which leads to a conveyor belt assembly that is lighter overall. Because it takes less electricity to function, a lighter conveyor system may be helpful in terms of energy efficiency. This is because it moves less material.

Better Belt Tracking The use of thinner studs has the potential to contribute to better belt tracking. This is particularly true in situations in which the belt has a tendency to stray or diverge from its intended route. Because of the shorter height of the studs, the lateral stresses that are imposed on the belt may be minimised. This results in improved alignment as well as less wear on the components of the conveyor.

Increased Material Capacity Because the thickness of the studs has been decreased, there is now more room on the conveyor belt accessible for the transfer of materials. This may result in enhanced material capacity and throughput, which in turn makes it possible to achieve higher production rates and greater overall productivity.

Savings on production Costs Thinner cleats often need less material during the production process, which may result in savings on manufacturing costs. Additionally, the decreased weight of the studs and conveyor belt assembly may result in less shipping costs as well as possibly decreased power usage over time, which leads to cost savings in operational areas.

Moreover,advantage of adding grib in top of cleat was Increasing the amount of grip that studs in a conveyor have may result in various benefits, including the following:Enhanced grip may give improved traction on the conveyor belt, therefore cleats with this feature are a good investment. When working with materials that are either heavy or slippery, this is a very useful skill to have. The enhanced grip makes it easier to avoid slippage and guarantees that the materials are conveyed down the conveyor in a safe and secure manner.

Stability is improved thanks to grippy studs, which also contribute to maintaining stability when being transported. They lessen the likelihood of items moving laterally or altering position on the conveyor belt, which in turn lessens the likelihood of product damage or leakage.

Increased productivity: gripping studs improve traction and stability, allowing the conveyor to work at faster speeds without sacrificing safety. This results in a larger throughput of material. since of this, it may be possible to boost both productivity and throughput since a greater quantity of materials may be delivered in an effective manner within a certain amount of time.

A conveyor system that has cleats that give enhanced grip has been shown to lessen the incidence of worker accidents or injuries. This results in increased worker safety. When personnel are operating on or near the conveyor belt, this reduces the likelihood that they may slip and fall.

Grippy cleats allow the conveyor to handle a wider variety of materials, which contributes to the conveyor's versatility in terms of material handling. The improved grip allows dependable delivery of any substance, regardless of whether it is loose, wet, or slippery. This helps to reduce material leakage and maintains operating efficiency.

Reduced maintenance: The increased traction provided by studs may assist in lowering the amount of wear and tear experienced by the conveyor system. Because it prevents slippage, it lessens the likelihood that the studs will get damaged or dislodged, which in turn reduces the number of times they will need to be maintained or replaced.In term of materials we are using Metal (Stainless steel).

3.6 SOLIDWORKS SOFTWARE

3.6.1 SOLIDWORKS DRAWING

As can be seen in Figure, sketches may either be well specified, inadequately defined, or excessively defined. When a drawing is completely defined, all of the lines and curves in the sketch, in addition to their placements, are characterised using either dimensions or relations, or both. It is not necessary to completely characterise drawings before putting them to use in the creation of features. Nevertheless, this project should clearly clarify drawings in order to preserve the purpose of this projectr designs. The black line art represents the fully formed drawings.

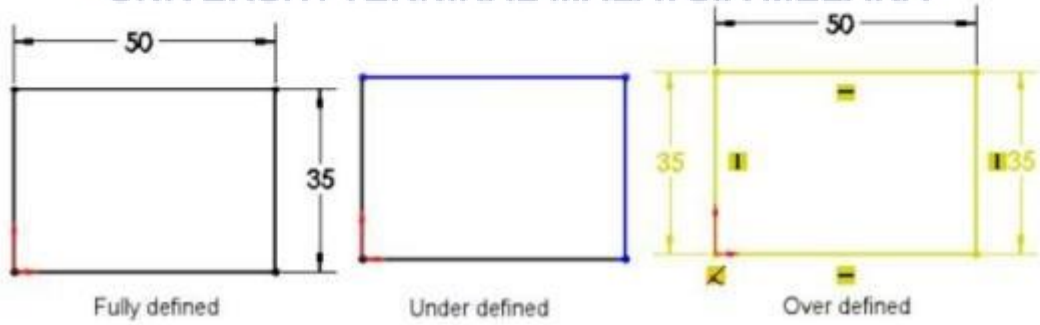


Figure 49 Type of sketch (3D CAD Design Software | SOLIDWORKS, n.d.)

3.6.2 SOLIDWORKS PART

Following the completion of the drawing, the component will be generated in SOLIDWORKS using the software's many functions. There are many various types of features, some of which are displayed in Figure, including extrude, cut-extrude, loft, shell, and fillet, amongst many more. The characteristics must be selected in accordance with the design that is desired to be produced.

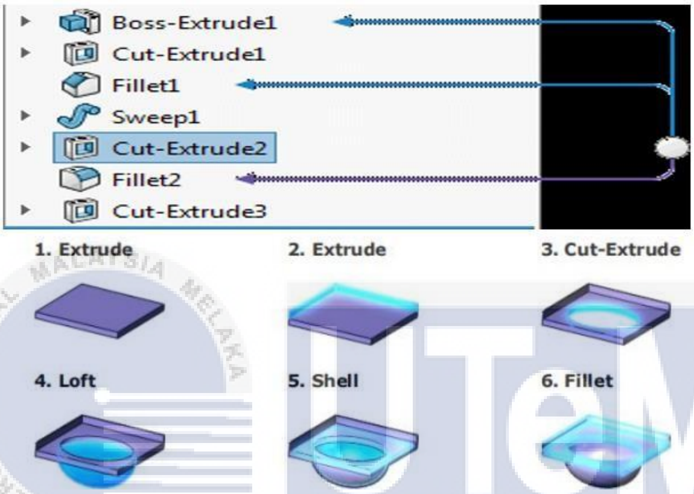


Figure 50 Type of features in solid works(3D CAD Design Software | SOLIDWORKS, n.d.)

3.6.3 SOLIDWORKS ASSEMBLE

After the individual pieces have been manufactured, the assembly process may begin. Assembly mates are what are used to specify the relationships between the many components that make up an assembly. As can be seen in Figure, there are a variety of various types of mates, including those that are coincident, concentric, parallel, tangent, and perpendicular. Advanced mates are also available in SOLIDWORKS, and they include things like profile centre, symmetric, width, route mate, and linear or linear coupler (see Figure for an example).

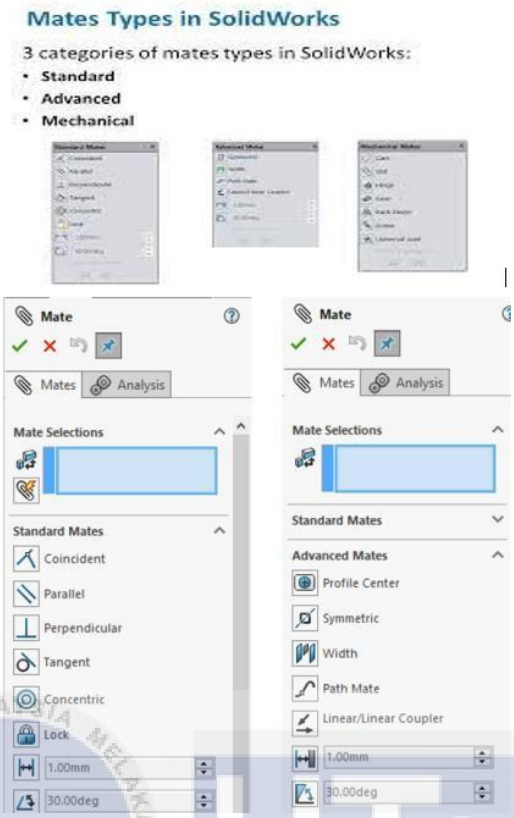


Figure 51 Type of mate in Solidworks (3D CAD Design Software | SOLIDWORKS, n.d.)

3.7 MILLING

Milling is the most common sort of machining, which refers to the process of removing material. This process includes removing unwanted material from a product in order to give a variety of characteristics. In order to do a milling operation, this project will need a milling machine, this projectr workpiece, a fixture, and a cutter. The workpiece, which is a piece of material that has already been preshaped, is held in position inside the milling machine by the fixture, which is attached to a platform within the machine. The milling machine is equipped with a cutting tool known as the cutter. This cutter has pointed teeth and rotates at a high speed. Feeding the workpiece into the revolving cutter will remove material from the workpiece in the form of very small chips, which will then be used to make the desired shape. The milling machine that will be used for the project is shown in figure below.

Figure 52 Conventional Milling Machine D. (n.d.)

3.7.1 DRILLING PROCESS

During the drilling process, a drill bit is rotated, which results in the creation of a hole in solid materials with a circular cross-section. It is necessary to replace the chuck with the drill chuck, as seen in Figure in order to keep the drill bit in position while drilling is being done. Figure below provides a visual representation of the drilling process.

Figure 53 Drill Chuck (Heinemann, 2018)

Figure 54Drilling Process (Heinemann, 2018)

3.8 LASER CUT

A concentrated beam of the laser light is employed in the basic thermal phase of laser cutting. This allows the material to be melted in a particular spot on the workpiece. A co-axial gas jet is used to create a kerf while at the same time the molten material is expelled. When utilising a CNC to make cuts, a continuous cut may be achieved by moving either the workpiece or the laser beam. There are three primary varieties of laser cutting, which are fusion cutting, flame cutting, and remote cutting, as shown in Figure below. Laser cutters make use of lasers of the three primary varieties, which are CO_2 lasers, fibre lasers, and neodymium lasers. The laser cutters are distinct from one another despite the fact that their construction is rather comparable. This is due to the fact that various kinds of lasers each have their own unique power range, which allows them to cut through a variety of materials.

Figure 55 Laser cutting. (The Hi-precision Sheet Cutting Process by Laser Cut – MIA Partner Research Consultancy This projectr Gateway to Central & East European Business, n.d.)

3.9 PROCEDURE

Steps	Explanation
1.	• Sketch the final concept design in solid works
2	• Design each part by part by using solid works features.
3	• Assemble the design in solid works
4	• Make Finite Element Analysis
5	• Mark the dimension in steel • Mark the dimension that needed to be cut and extrode • Mark the side and top pattern • Mark the holes needed to be drilled
6	• Cutting the parts using the laser cut • Cut the steel according to the required dimension. • Cut the edge according to the required dimension
7	• Smoothen the freshly cut parts using grinder. • Cut the excess part that laser cut missed
8	• Assemble all the parts using mig welding if needed.

9	• Drill the holes using marked spots • Holes with the different diameter for the trash trapping comb
10	• Carry on milling process.
11	• Repeat step 5-10 if the design is unsuccessful
12	• Field Test
13	• Take Data and Analysis

Table 3: Procedure

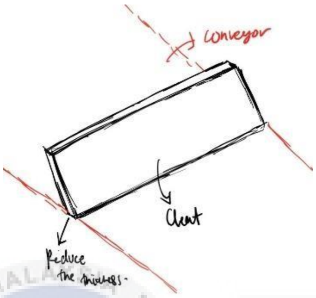
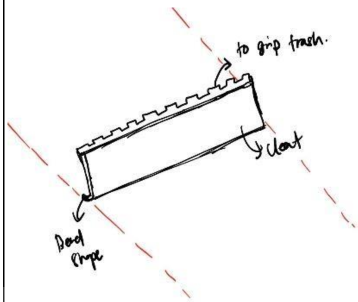
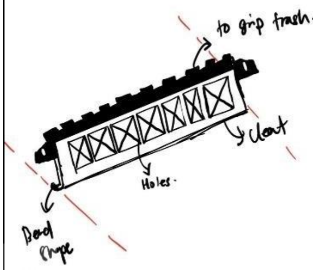
CHAPTER 4

RESULT AND ANALYSIS

4.1 INTRODUCTION

This chapter will provide a concise overview of the findings and subsequent analysis regarding the Trash trapping comb for trash collector system. The results of the study are consistent with the concept selection method, which employed a two-stage of Trash trapping comb for trash collector system which is the Pugh Method and the SolidWorks Simulation. Analyze the mechanical structure of the Trash trapping comb for trash collector system using finite element analysis with the SolidWorks software to simulate and analyze its stress, strain, displacement, and factor of safety once the product has been developed.

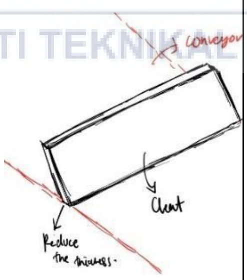
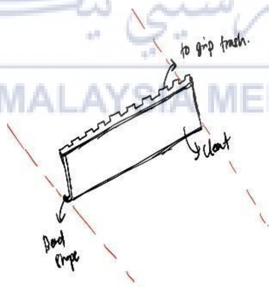
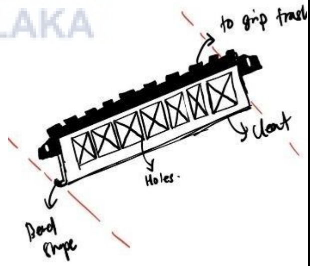
4.2 PUGH METHOD

	OPTION		
CRITERIA	DESIGN A  	DESIGN B  	DESIGN C 
EFFICIENCY OF THE PRODCUT	+	+	+
AFFORDABLE	+	+	+
DURABLE	-	-	+
THICKNESS	+	+	+
LIGHTWEIGHT	+	+	+
MULTIFUNCTION	-	-	+
MAX LOAD	-	-	+
MATERIAL	-	+	+
TOTAL +	4	5	8

TOTAL -	4	3	0
TOTAL SCORE	0	2	8

Table 4: Pugh Method Table

In accordance with the Pugh Method, design idea 3 receives a significant number of positives (+) due to the fact that it meets the essential requirements. The final design concept is the first one, followed by the second and third design concepts. In order to indicate that the criteria of The Design Concept cannot be satisfied, certain needs have been marked with a negative character (-). Now that we have this information, we are able to determine which of the design concepts shown in Table 5 is the most superior.

Weighted decision matrix							
		Options					
							
Criteria	Weighting	Design A		Design B		Design C	
		Score	Total	Score	Total	Score	Total
EFFICIENCY OFTHE PRODCUT	5	4	20	5	25	5	25

AFFORDABLE	5	5	25	5	25	5	25
DURABLE	5	3	15	4	20	5	25
THICKNESS	5	5	25	5	25	5	25
LIGHTWEIGHT	5	5	25	5	25	5	25
MULTIFUNCTI ON	5	3	15	4	20	5	25
MAX LOAD	5	3	15	4	20	5	25
MATERIAL	5	4	20	5	25	5	25
Total		Total	160	Total	185	Total	200

Table 5: Weighted decision matrix

Table 5 demonstrates that all of the criteria obtained a score of five in the weighted, thickness, and affordability categories. This is because three of the criteria scored the greatest possible score. It is possible to determine the overall score for each design once all the values have been taken into consideration. Considering all of the design criteria ultimately lead to the determination of the worth of each design. Following the assignment of values to each design, design C is awarded the highest overall score, followed by design B and design A in that order. There is a distinction between design A and design B in terms of their overall score, and this distinction is due to the criterion score. When it comes to the product material, design B earns a better score than design A does. The fact that the product is not only inexpensive but also long-lasting, multifunctional, robust, and material is the primary reason that design C was awarded the best grade.

4.3 THE DRAWING OF TRASH TRAPPING COMB

Finalization has been made on the concept design of the Trash Trapping Comb. The analysis of the detail design has been covered in several perspectives of the design. Students at UTeM are already familiar with the SolidWorks application, which is used to execute the drawing of the design. The features that are offered by SolidWorks are simple to identify and may be easily applied to the region that is appropriate for the purpose. Considering this, the final concept of the Trash Trapping Comb may be simply accomplished through the use of SolidWorks. The following is an illustration of the idea design for the Trash Trapping Comb:

Top View

Figure 56 Top view of Trash Trapping Comb

Side View

Figure 57 Side View of Trash Trapping Comb

Front View

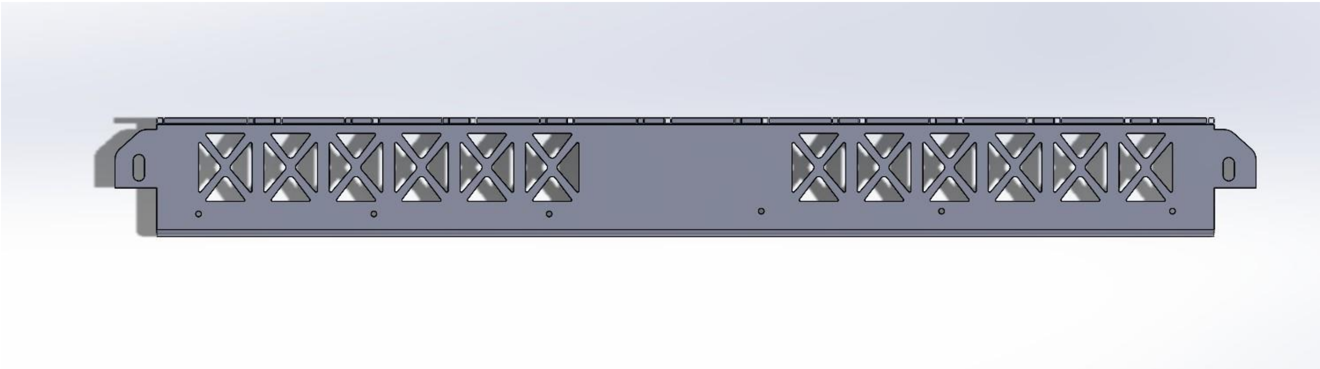


Figure 58 Front View of Trash Trapping Comb

Isometric View

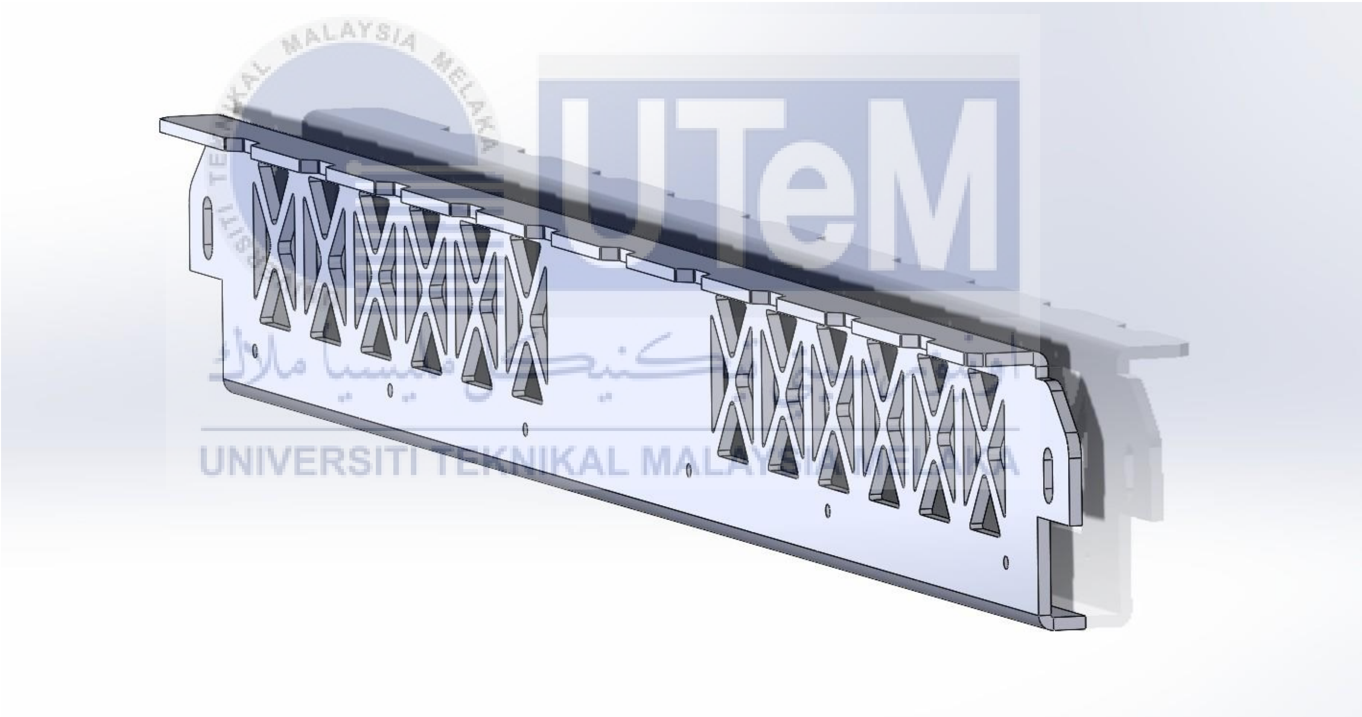


Figure 59 Isometric View of Trash Trapping Comb

4.4 SIMULATION OF TRASH TRAPPING COMB

After the parts of the Trash Trapping Comb for trash collector system were drawn in Solidworks with the exact dimension and applied exact material. The simulation was done with Solidworks 2023 simulation software.

4.4.1. PRE-PROCESS OF TRASH TRAPPING COMB

Beginning with the sketching of the components in accordance with the dimensions and then extruding them to make them three-dimensional, the pre-process of the Trash Trapping Comb for trash collector system begins. After finishing all of the sketching procedures, each component chose the materials that it would use in order to get more precise outcomes in the simulation. In the following step, each component was put together in accordance with the drawing. The use of material characteristics to the design of trash trapping combs in SolidWorks Simulation is an easy procedure. Some examples of such materials are mild steel. The material mild steel is applied in the manner that is demonstrated below.

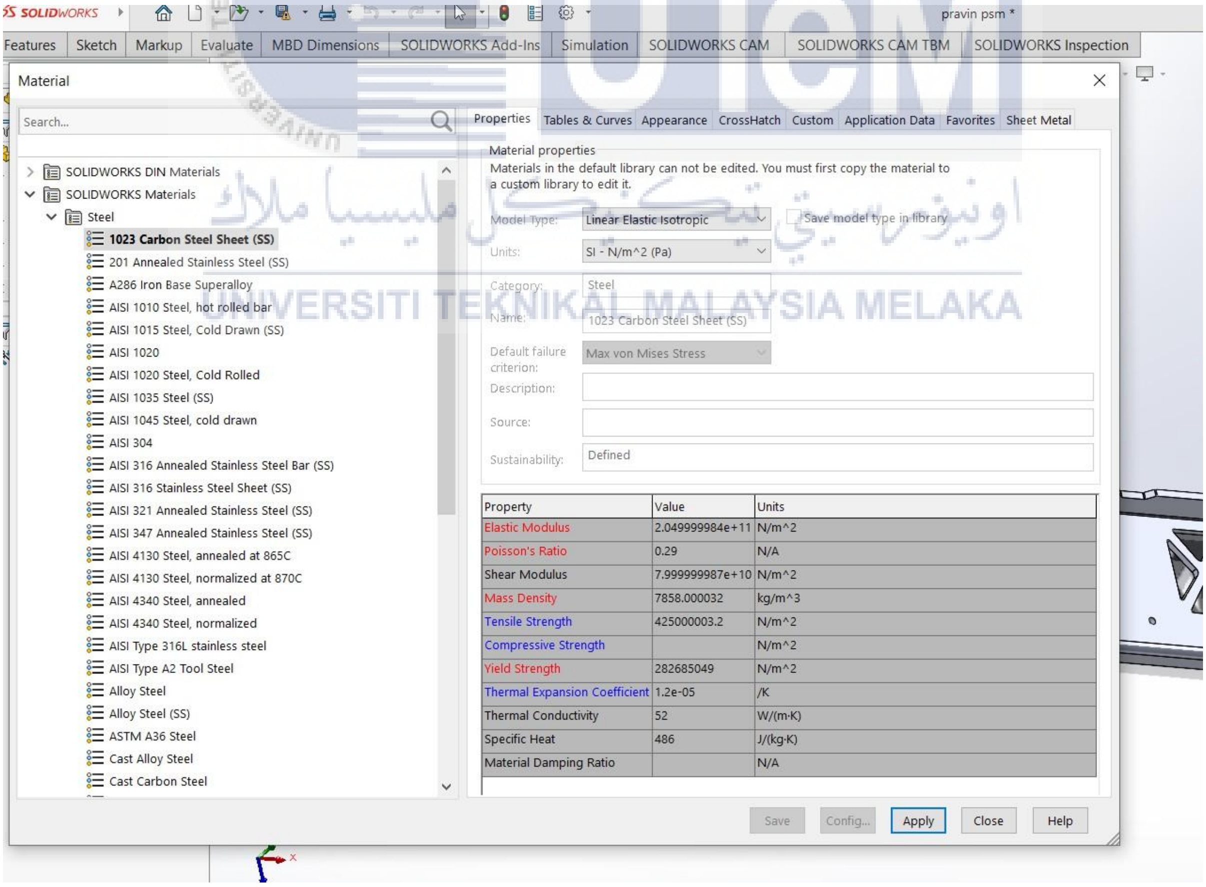


Figure 60 Apply Material in Trash Trapping Comb Design

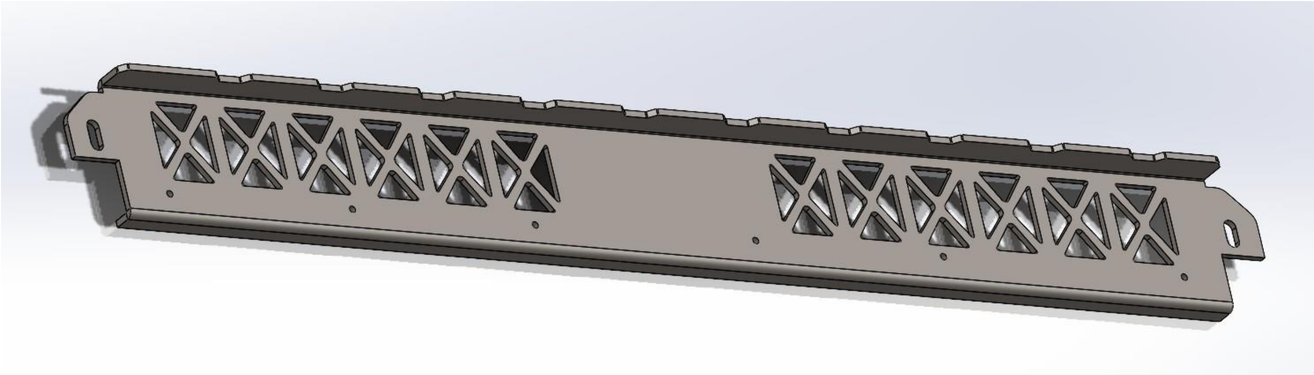


Figure 61Material applied in Trash Trapping Comb design.

When building a model for simulation studies, the use of fixed geometry is an essential component. This is especially true in situations when structural analysis is necessary. In its most basic form, fixed geometry is a boundary constraint that limits the mobility of particular components or features inside the model. This is very necessary in order to correctly simulate the behavior of a structure when it is subjected to loads or forces from the outside. Because these fixed positions reflect sites at which the structure is either supported or constrained, it is possible to simulate the structural reaction to applied forces in a manner that is more accurate. The use of fixed geometry in the correct manner is absolutely necessary in order to acquire relevant and accurate simulation results. These results offer insights into the functionality and safety of the component or structure that has been created. The screw hole and the bottom of the trash trapping comb will be the locations where the fixed geometry will be.The green marked spots are where the fixed geometry was applied.

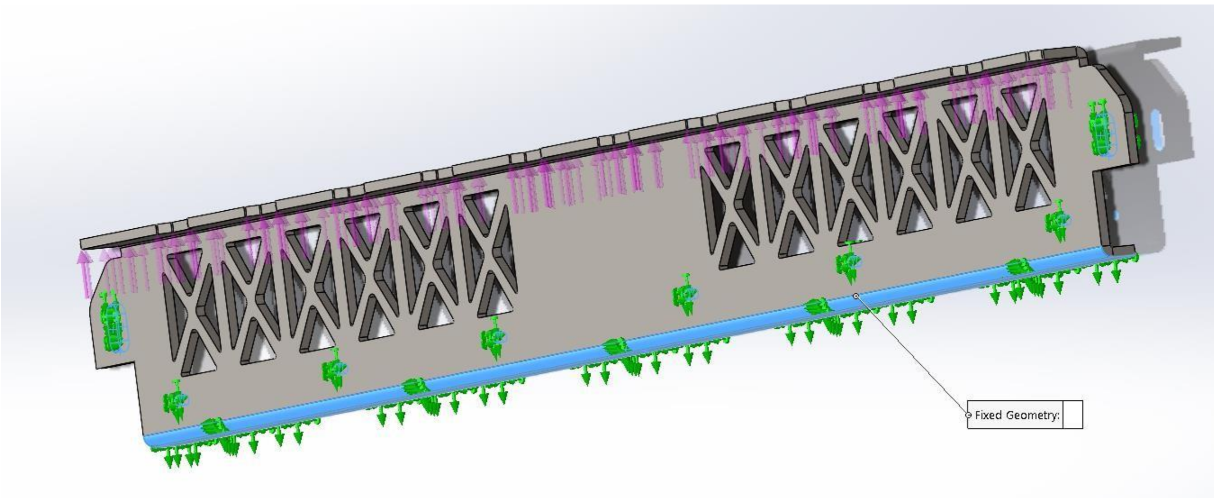


Figure 62 Applied fixed geometry in trash trapping comb design.

One of the most important steps in the process of simulating the reaction of a model to external loads is the application of a force. This stage is used to evaluate the structural integrity and performance of the trash trapping comb design. Since force will only be applied at the top of the design, the force will be applied at the top area on the top spot, which indicates the placement of the trash. However, the force will be applied at the top area. This force is equal to 98.1 Newtons. This particular level of power was chosen because of the fact that the typical weight of the trash is ten kilograms. The answer will be 98.1N after it is translated into the unit of N. Where the force has been applied is indicated by the purple patches on the map.

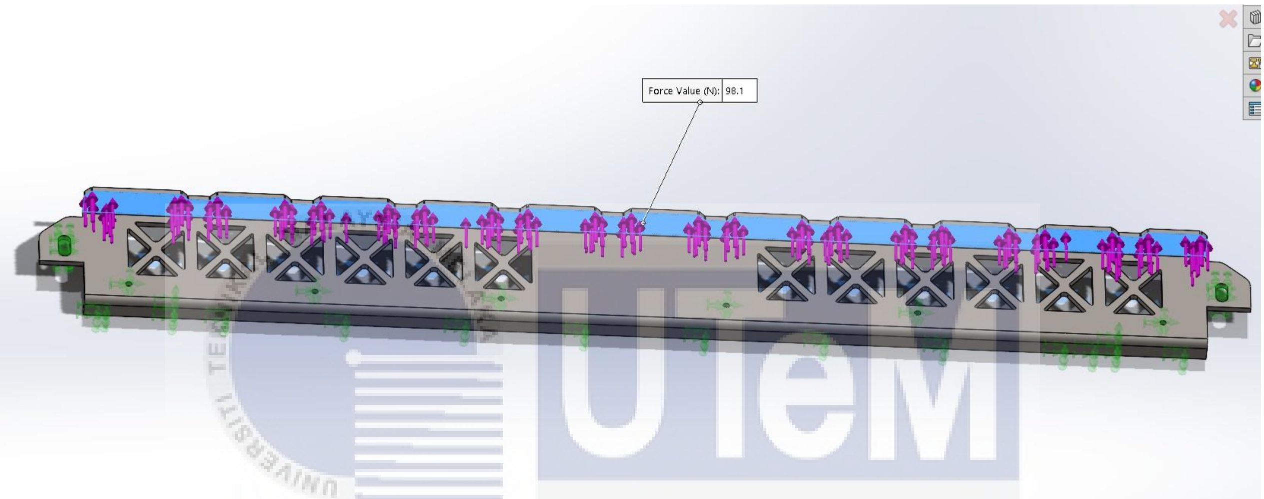


Figure 63 Applied force.

Meshing is a vital stage in the finite element analysis process, when a complicated geometry is broken into a limited number of smaller, simpler elements. This mesh, made of nodes and components, serves as the computational foundation for simulating the behavior of the model under various loading circumstances. The relevance of meshing resides in its direct influence on the accuracy and dependability of simulation outcomes. A well-refined mesh, with smaller and more closely spaced elements in crucial sections of the model, gives a more accurate representation of the geometry and assures that the simulation catches precise stress concentrations, displacements, and other structural characteristics. However, meshing also entails a trade-off, since overly tiny meshes can increase computing time. It is crucial to come up with a solution that strikes the correct balance between mesh refinement and computing efficiency. The model of trash trapping comb is discretized or meshed as the last stage in the pre-process. A multitude of mesh alternatives are offered in SOLIDWORKS, including the Solid, Shell, and Beam mesh types. However, the mesh in this simulation is solid mesh.

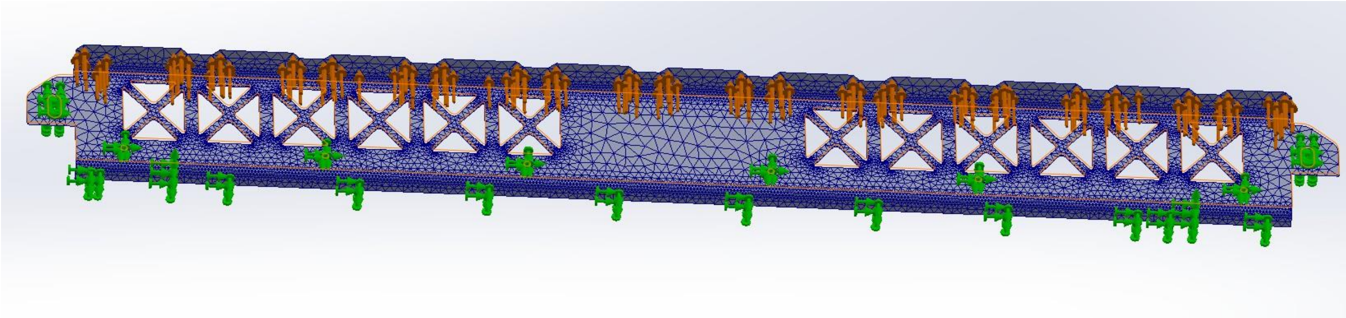
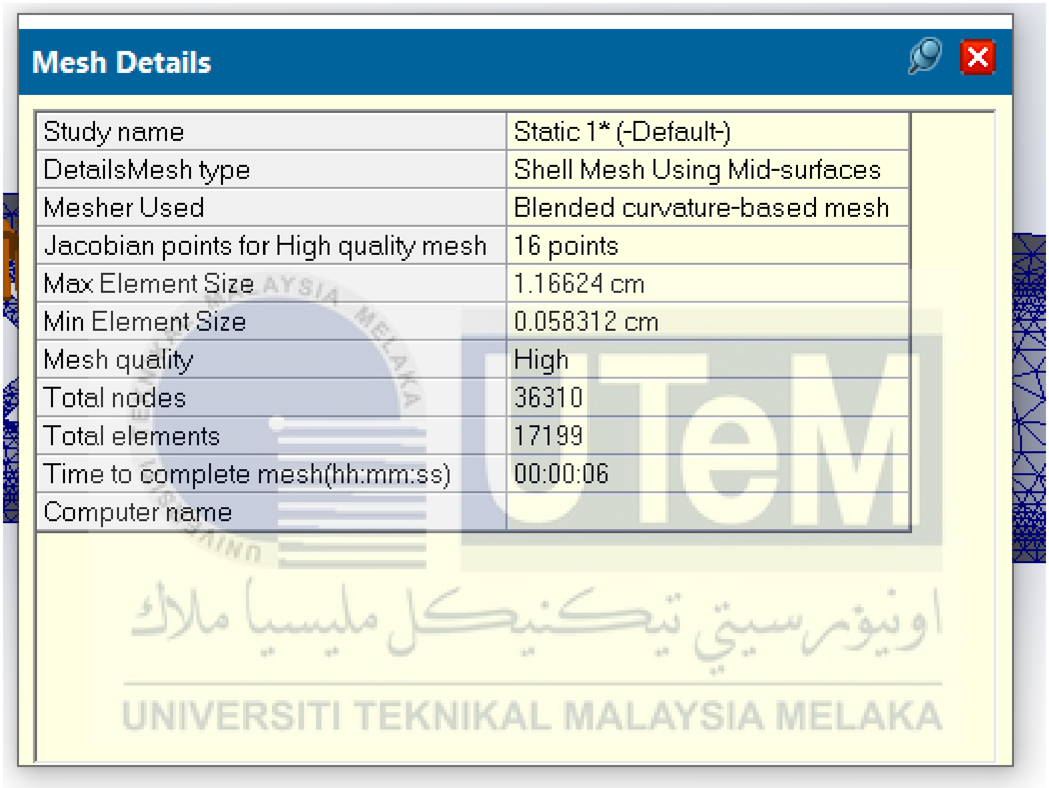


Figure 64Mesh applied.



Mesh Details

Study name	Static 1* (-Default-)
DetailsMesh type	Shell Mesh Using Mid-surfaces
Mesher Used	Blended curvature-based mesh
Jacobian points for High quality mesh	16 points
Max Element Size	1.16624 cm
Min Element Size	0.058312 cm
Mesh quality	High
Total nodes	36310
Total elements	17199
Time to complete mesh(hh:mm:ss)	00:00:06
Computer name	

Figure 65Mesh details

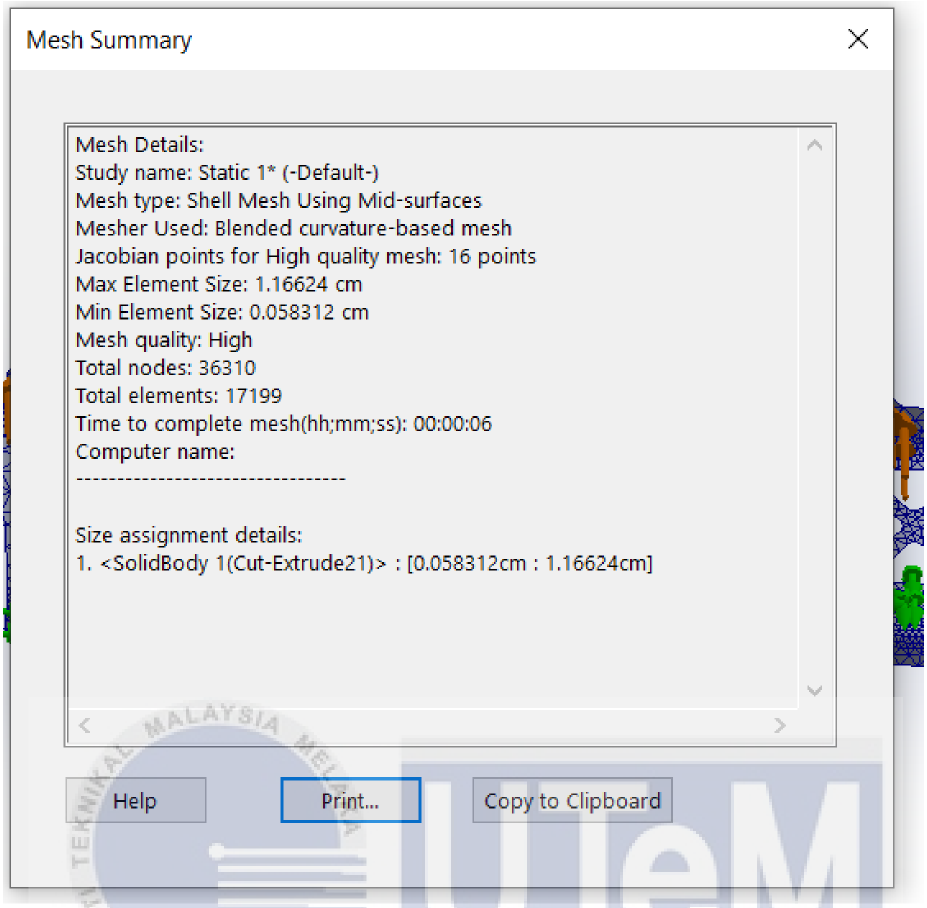


Figure 66 Mesh Summary

4.4.2 POST-PROCESS OF TRASH TRAPPING COMB

In the simulation of a trash trapping comb, the post-process is the result of the simulation. The most common types of post-processes include stress, displacement, strain, and factory of safety. The smallest possible value is 1.000x10-30. 6.757x10-7 is the greatest displacement value that was obtained.Therefore, the structure is able to withhold the force that is being delivered to the plane. Since the material has already been applied, the outcome is reliable and may be referred to prior to beginning the process of production.

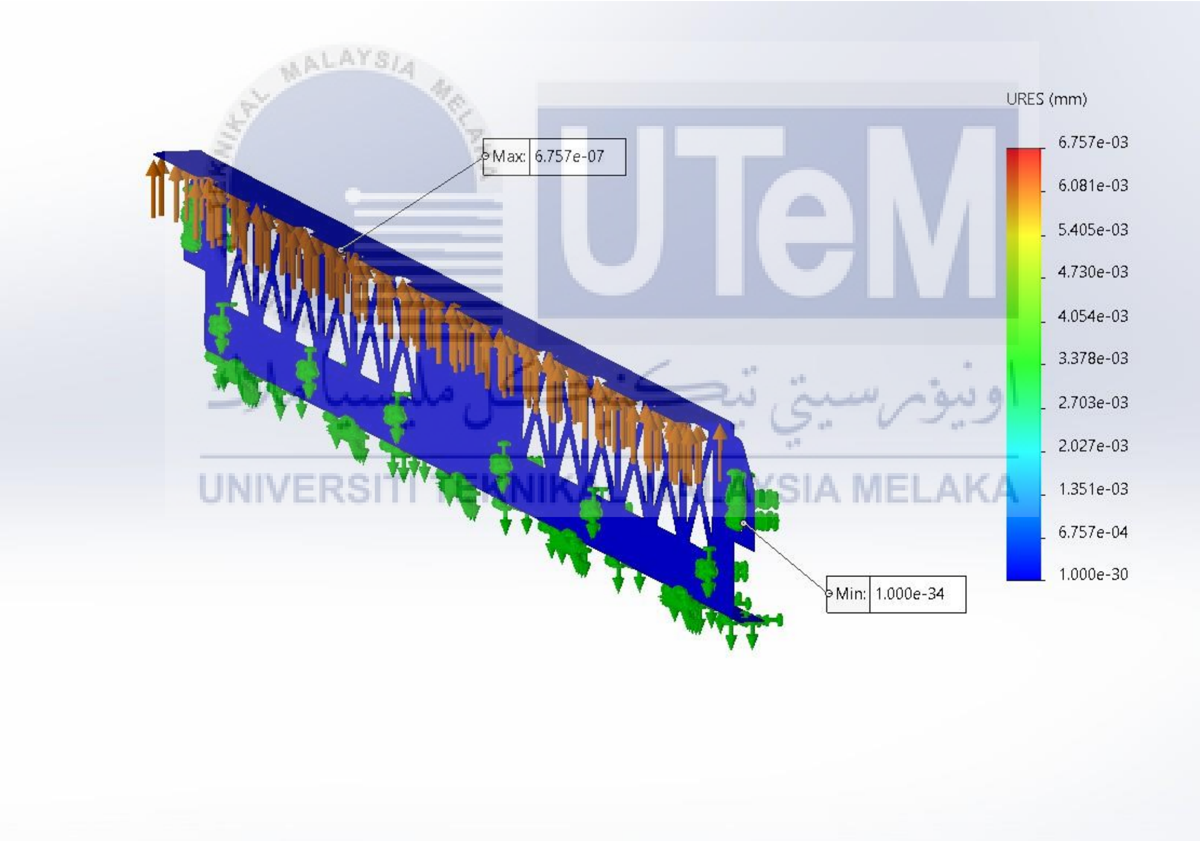


Figure 67 The result of simulations in terms of displacement.

In terms of the stress, the highest possible value is 4.509X10+2, while the lowest possible number is 0. The pressure that a material experiences as a result of being subjected to a load is referred to as stress. A load will scatter itself across a material in a manner that is determined by its stiffness. A representation of the status of the trash trapping comb was provided by the Force throughout the exercise. In light of the fact that it reveals that the trash trapping comb is still in good form, the yield strength of this material is suitable for the product. The yield strength of a material expresses the tension that must be exceeded before the material's deformation may be considered plastic. Any deformation that cannot be reversed happens as a result of a stress that is greater than the yield strength. For the reason that elastic deformation is linear, yield strength is frequently referred to as the maximum stress that can be given without deviating from the 88 proportionalities of stress and strain. This is because of the linear nature of elastic deformation. When yield strength is used, the safety factor may be calculated by dividing the greatest permitted stress by the equivalent stress (von-Mises). This ratio is used to determine the safety factor. For the design to be regarded acceptable, it must have a value greater than 1. The presence of some persistent deformation is indicated by a number that is less than 1. Through the findings of the safety factor, it is possible to easily identify areas that have the potential to produce. The highest site of stress in the associated stress results is highlighted in red, regardless of how high or low the figure is. This is the case regardless of the circumstances. The material is very close to reaching its yield when the factor of safety is equal to one.

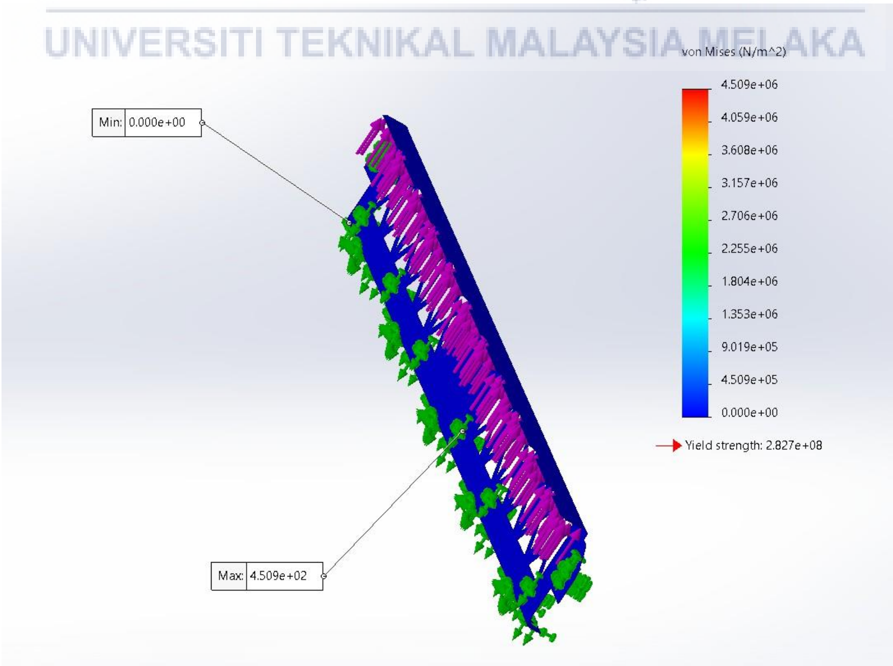


Figure 68 Result of simulation in term of stress

Strain is calculated by dividing the amount of deformation the body experiences in the direction ofthe applied force by the body's starting dimensions. The maximum value is 1.124x10-9 and the minimum value is 0.0^{0}.

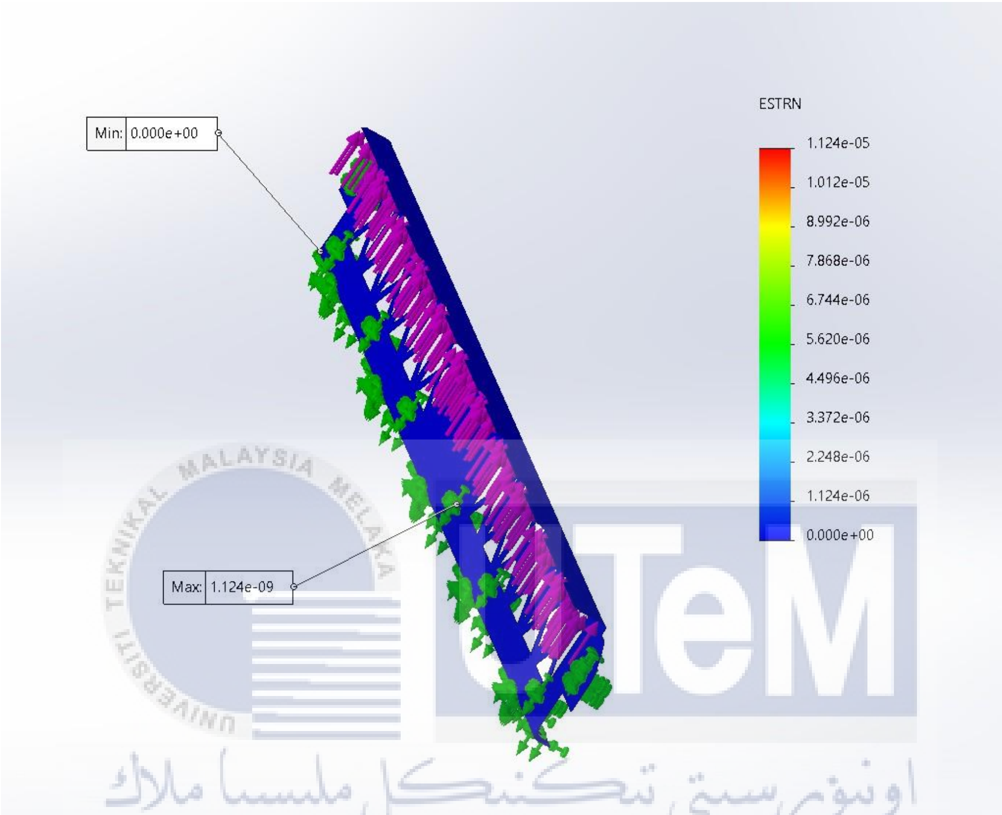


Figure 69 Result of simulation in term of strain

One of the most important engineering concepts, the factor of safety is utilised to determine the margin of safety that exists inside a design or building. The ratio of the maximum load that a structure or component is able to sustain to the load or stress that it is subjected to when that structure or component is in operation is what it signifies. A factor of safety that is more than one implies that the structure is taken into consideration to be safe, provided that there is a specified buffer between the load that is being applied and the capacity of the material. On the other hand, a factor of safety that is less than one indicates that the load that is being applied is getting close to or surpassing the limitations of the material, which indicates that there is a possibility of failure.Factor of safety for trash trapping comb’s design is 63.It is greater than 1.So, the design is consider is safe to use.

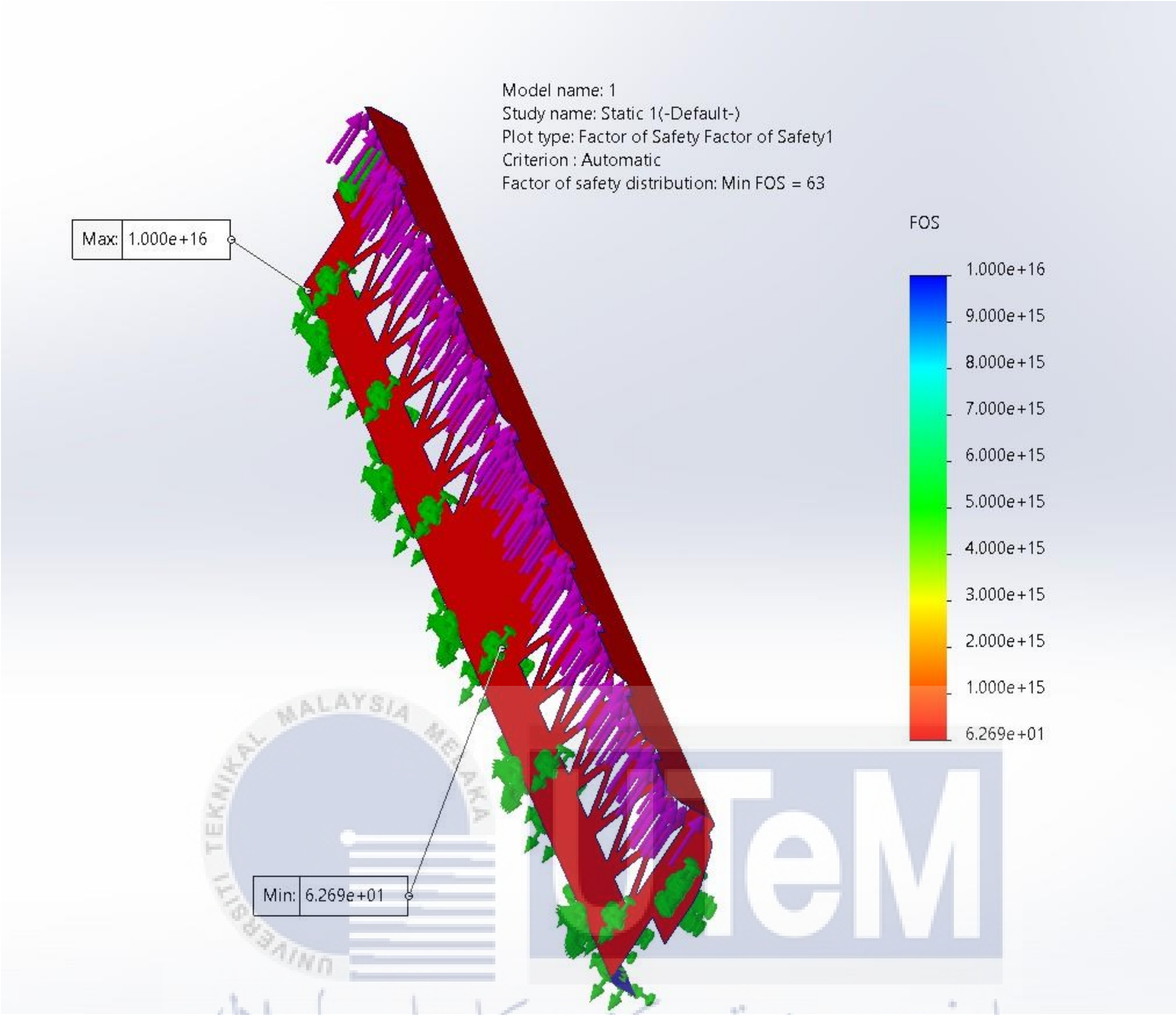


Figure 70 Result of simulation in term of factor of safety

4.5 THE FABRICATION OF TRASH TRAPPING COMB

After successfully carrying out all the fabrication steps, the figure below shows the front view,side view, top view and isometric view of trash trapping comb from various angle.

Figure 71 Front view of trash trapping comb

Figure 72 Side view of trash trapping comb

Figure 73 Top view of trash trapping comb

Figure 74 Isometric view of trash trapping comb

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

The entirety of the project, which is a trash trapping comb for a trash collector system, will be discussed in this chapter, along with its conclusion and recommendations. Discussion will take place about the successful completion of the project's purpose. In addition to this, the recommendation for the upcoming research about the trash trapping comb for the trash collector system will also be suggested.

5.2 CONCLUSION

It may be concluded that the project's goal has been successfully completed. First and foremost, the Pugh approach should be utilised to develop a lightweight trash trapping comb for the trash collector system in the river. A demonstration of the fact that the material and the design of low weight have been completed is provided by the result of the Pugh method in chapter 4.It is necessary to use finite element analysis in order to investigate the mechanical structure of the trash trapping comb for the trash collector system. Due to the fact that the factor of safety is larger than 1, the analysis performed in SolidWorks provides a detailed representation of the mechanical structures consisting of stress, strain, displacement, and factor of safety.An analysis of the Trash Trapping Comb was carried out and completed with success and accomplishments. However, the field test at Malacca River cannot be implemented due to the lack of time. This is because a lot of time has been used to develop all the parts of Environment-Conveyed Automated loT PONTOON (En-COOTIP) and all the parts required different kind of laboratory to do the fabrication process.

5.3 RECOMMENDATION

First and foremost, the top dimension of the trash trapping comb should be increased. This is the modification that may be suggested for the trash collector system's trash trapping comb.When tested, it was able to apply a greater amount of load. On the other hand, not only did it need a substantial amount of money to purchase the material, but the machining process also demanded a significant amount of money and time in order to develop the components. It is necessary to conduct field tests in order to ascertain whether or not it is functioning well. This is the other modification that may be made.

5.4 PROJECT POTENTIAL

A transformational combination of technical breakthroughs and environmentally responsible waste management techniques is where the potential for the future of trash collector systems resides. These systems have the potential to develop into solutions that are data-driven and extremely efficient provided that they are integrated with smart technology. It will be possible to perform real-time monitoring of garbage bins, optimise collection routes, and schedule collections depending on fill levels thanks to the implementation of advanced sensors, Internet of Things (IoT) devices, and artificial intelligence. This not only cuts down on the amount of gasoline used and the amount of carbon emissions produced, but it also improves operating efficiency. In addition, the utilisation of drones and robots in the process of trash collection has the potential to improve the overall performance of the system, which may lead to more efficient waste management in places that are highly inhabited or have tough terrain. The future trash collector system is positioned to be a significant participant in developing cleaner, more sustainable communities, harmonising with the worldwide push towards circular economies and responsible resource management. This is anticipated to occur as environmental consciousness continues to rise.

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APPENDICES

Appendix 1 Gantt Chart PSM 1

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	WEEKS 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Title Selection	1	1	1	1														
Planning and Research	2	2	2	2														
Chapter 1																		
Background, Problem Staement	3	2	3	2														
Objective, Scope	3	3	3	3														
Chapter 2																		
Literature Rivew	3	5	3	5														
Chapter 3																		
Project Planning	5	2	5	2														
Problem and Failure	6	2	6	2														
SOLIDWORKS software	6	2	6	2														
Altair solidThinking	7	2	7	2														
SLS 3D Printing	7	3	7	3														
MIG Welding	7	4	7	4														
Grinding	7	4	7	4														
Aluminium Profile	8	5	8	5														
Chapter 4																		
Improvement	7	6	7	6														
Others																		
ELog Book Weekly	1	12	1	12														
Report Progression	1	12	1	12														
Video Presentation	11	1	11	1														
QnA Session	12	1	12	1														

Appendix 2 Gantt Chart PSM 2

TIME (WEEK) / ACTIVITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PROJECT BRIEFING	COMPLETED								COMPLETED						
EXPERIMENTAL SETUP		COMPLETED													
DATA COLLECTION				COMPLETED											
RESULT ANALYSIS						COMPLETED									
RESULT VERIFICATION												COMPLETED 90%			
CONCLUSION AND RECOMMENDATION													COMPLETED 80%		
WEEKLY REPORTING (LOGBOOK)	COMPLETED 80%														
PROJECT REPORTING					COMPLETED 80%										
4 PAGES SUMMARY														COMPLETED	
PRESENTATION AND SLIDES														COMPLETED 90%	

Appendix 3 SolidWorks design of Trash Trapping Comb.