DESIGN IMPROVEMENT OF HYDRO QUALITY MONITORING SYSTEM

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DECLARATION

I declare that this project entitled " Design Improvement Of Hydro Quality Monitoring System " is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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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 of Manufacturing Engineering Technology (Product Design) with Honours.

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DEDICATION

This report is dedicated to everyone who supported me during my preparation of this report. My thanks to everyone, including my parents, supervisor, comrades-in-arms, the people around me for the encouragement and myself

To My Beloved Parent

Abdul Malik bin Jamaluddin

Yesiana

For my repected supervisor

Mazran bin Ahmad

and for my co supervisor

Ts. Dr. Nur Rashid bin Mad Nuri @ Md Din

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Thank you for support, sacrifice and always been there in every up and down

ABSTRACT

River is main water source for all human mankind. River are able to be used in many ways such as industrial, agricultural, recreational, and many more. A dirty river are able to be lead to many consiquences. In Melaka, a well known river named as Melaka River or the local name is 'Sungai Melaka' have encountered many issue such as dirty river, dead fish, the spike of mineral and many more. A previous HydroQS have been made consist 5 type of parameter sensor but there is many issue such as leakage, unable to float, sensor faulty reading and many more. The objective for this project is to conduct a design study on previous HydroQS. After the experiment have been conducted, it need to be improved and to fabricate the latest version of HydroQS. In this project, previous HydroQS have been studied and been found the detail of the weakness point. To encounter that issue, a holder have been made to overcome the weakness. The fabrication of the HydroQS holder was fabricated starting from the design selection. After the design selection, the design was simulated by using solidwork simulation to ensure the strenght, the maximum displacement and factor of safety was achieve its target. After the target been achieved, the fabrication was made from the metal and joined by welding to ensure the join have highest strenght. Pre test and a field test is needed to ensure the simulation and real life experiment having an almost accurate result.

ABSTRAK

Sungai merupakan sumber air utama bagi seluruh umat manusia. Kegunaannya amat luas, mulai dari industri, pertanian, rekreasi, dan banyak lagi. Namun, sungai yang tercemar dapat menimbulkan berbagai akibat buruk. Di Melaka, Sungai Melaka yang terkenal, atau dipanggil 'Sungai Melaka' oleh penduduk setempat, menghadapi banyak masalah seperti air yang kotor, ikan mati, peningkatan mineral, dan banyak lagi.Sebelumnya, telah dibuat sebuah HydroQS dengan lima jenis sensor parameter. Namun, terdapat banyak masalah seperti kebocoran, tidak dapat mengapung, pembacaan sensor yang salah, dan banyak lagi. Projek ini bertujuan untuk melakukan kajian terhadap rekabentuk HydroQS sebelumnya. Setelah eksperimen dilakukan, perlu dilakukan perbaikan dan pembuatan versi terbaru HydroQS.Dalam proyek ini, HydroQS sebelumnya telah dipelajari dan ditemukan titik-titik kelemahannya secara detail. Untuk mengatasi masalah tersebut, dibuatlah sebuah penyangga untuk mengatasinya. Pembuatan penyangga HydroQS dimulai dari pemilihan desain. Setelah pemilihan desain, desain disimulasikan menggunakan SolidWorks untuk memastikan kekuatan, perpindahan maksimum, dan faktor keamanan mencapai target. Setelah target tercapai, pembuatan dilakukan dari logam dan disatukan dengan pengelasan untuk memastikan sambungan memiliki kekuatan tertinggi. Pra-uji dan uji lapangan diperlukan untuk memastikan simulasi dan eksperimen di kehidupan nyata memiliki hasil yang hampir tepat.

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LIST OF SYMBOLS AND ABBREVIATIONS

PPSPM	-	Perbadanan Pembangunan Sungai Dan Pantai Malaysia
DOE	-	Department Of Enviroment
IoT	-	Internet of Things
WQI	-	Water Quality Index
NWQS	-	National Water Quality Standard
HydroQS	-	Hydro Quality System
Mg/l	-	Miligram per Liter
NTU	-	Nephelometric Turbidity Unit
DO	-	Dissolved oxygen
TDS	-	Total Dissolved Solid
°C	-	Celcius
PSM	-	Projek Sarjana Muda
SLS	-	Selection Laser Sintering
3-D	-	3 Dimension
mm	-	Milimeter
Cm	-	Centimeter
DC	-	Direct Current
ms	-	Milliseconds
g	-	Gram
M	-	Meter
L	-	litre
Mg	-	milligram
Psi	-	Pounds per square inch
ppm	-	Parts per million
°	-	Degree (angle)
M	-	Meter
	-	

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Hydro Quality System or the shortform is HydroQS is a low-cost device to monitor river water quality in real time. HydroQS have been include all the pH sensor, turbidity sensor, temprature sensor, DO sensor, and TDS sensor. All the sensor need to measure the parameter such as pH value, temperature, turbidity value, dissolved oxygen, and total of dissolved solids according to its sensor. A solar panel was used as the main power source of energy supply for the device functionality as the power solar absorb the sunlight energy during the day. During the night or less sunlight time, a battery 12V was used to backup the power. HydroQS also used with Arduino equipped with Internet of Things (IoT) as the lastest technology that able to transfer the data over the network. An interface also was made to make the data easier to be read through web or application in computer or smartphone. It is also have 4G/LTE as a secondary source of network option.

From the past research, Many effort have been made to ensure the quality and cleanliness of keeping river in various way. Before the usage of IoT technology, a study in Sungai Melaka have been made in 2017 by using the technique grab sampling. They been taking data from 9 different location. The water was collected by using polyethylene bottle without trapping any air bubble. All the sample that been taken was labbeled according to it location was taken into the laboratory. The sample also need to be kept at 4 °C in order

to minimize the microbial activity. The sample that been taken follow the APHA(2005) procedure.

The sample that been taken was measured by using special instrument according to their function. The parameter that been taken to measured is dissolved oxygen, pH value, temprature, turbidity value and the total number of dissolved solid. The tool that was used to determine pH in laboratory is Sevengo Duo Pro Probe from Mettler Toledo AG. The device are shown in figure 1.1 . The turbidity value was measured by using Handled Turbidimeter Hach 2100 such in figure 1.2 while to determine the temprature, and dissolved oxygen they use Orion Star Series Portable Meter in figure 1.3 (Hua, 2017). By having the old method, it is unable to maintain and measure quality and unable to tackle the fast moving problem. The problem have been spread to the coastal area if the slow action was taken (Rahman , et al., 2020)and incorrect billing.

Figure 1.1 SevenGO Probe Duo

Figure 1.2 Hach 2100 Handled Turbidimeter

Figure 1.3 Orion Star Series Meter

1.2 Problem Statement

The creation of previous design have many flaws in the design that make it unable to placed in Sungai Melaka. One of the factor is bad distribution of weight. The bottom

part of the body just have the sensor component while the middle of the part consist of electronic board and on the top of the body, it have a battery that is heavy and the camera.

The design is theoritically seems like it will sucessfully float and the pre-test result prove that it is able to float steadily in cistern but the previous design forget to consider about the stern wave that created from the tourist boat that cruising along the Melaka river.

1.3 Research Objective

The main aim of this research is to improve the previous design of hydro quality system. This study use a device that been named as HydroQS. Few aspect needed to be study in previous design. The objective is stated below:

a) To conduct a design study on previous HydroQS
b) To improve previous design of HydroQS
c) To fabricate HydroQS Holder

1.4 Scope of Research

The scope of this project are as follows:

- To study the limitation of the Previous hydoqs
- To simulate the HydroQS holder based on the
- To fabricate the HydroQS by using metal parts
- The method of metal joining is by using welding
- To simulate the holder of HydroQS by using solidworks analysis

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Water has played a fundamental role in the development and sustenance of human civilization. Throughout history, major cultures and civilizations have thrived near freshwater sources, highlighting the immense importance of water. Around 10,000 years ago, during the advent of the agricultural revolution, humans transitioned to a sedentary lifestyle, relying heavily on water for their settlements. However, this shift also brought new challenges as contaminated water became a significant health hazard for these communities. Ensuring access to clean water became essential for the growth of urbanization, state formation, and other societal advancements that followed, leading to significant demographic changes.

The interaction between human civilizations and water-associated risks necessitated the acquisition of knowledge and strategies to cope with these challenges. This process involved the transformation of perceptions, beliefs, attitudes, and behaviors that shaped the overall way of life for communities. According to Syarifah Khusnul Khotimah in 2019 Human activities cannot be separated from water. Often, with the increase in population, the demand for water quality also increases. One of the water sources widely used by humans to meet their needs is from the rivers (Khotimah & Nasruddin, 2022).

2.2 Water pollution

Water is considered as a pure substance in this world because of its behavior that is able to dissolve most of the material. That is a reason humans rely on water, especially water that comes from the river. As the civilization increases, there is also an increasing level of river pollution. Pollution means there is an additional substance including soil, liquid, gas and many more. There is another form of water pollution that is coming in energy forms like radioactive, sound and heat (Bănăduc, et al., 9 Dec 2022; Murali, 2023).

The quality of river water is getting worse as the goes by. Most common pollution that been made by human civilization that is easy to be seen is from solid and liquid. This is because pollution from the source has an impact on the turbidity of the water. All of that might come from multiple sources like agriculture that use excessive fertilizer and pesticide, irresponsible communities that dump plastic and food waste. Not to forget, the industrial dumping illegal substance that contribute to water pollution (ama, 2020)

Figure 2.1 Chemical waste from the industry

2.2.1 Type of water pollution

There is several water pollutions that occur around the world but the most leading issue is chemical pollution because it can contribute to many factor including alteration and degradation of river water, changes in temperature and pH levels, rises of harmful microorganisms and many more (Mat Saad, Abu Hassan Asari, Affandi, & Zid, 2022).

Chemical pollution has been affecting surface and underground river bodies. Chemical pollution come from multiple sources like agricultural area, urban area, and forest area (Camara, Jamil, & Abdullah, 2019). Solvent and metal that are used in industrial are polluting the river. Not to forget from the agricultural area, excessive usage of weed, insect and fungi control are contributing to the soil contamination and make a process called eutrophication occur.

Eutrophication means the biological reaction between the excessive growth of phytoplankton that leads to unbalanced primary and secondary productivity. The faster rate of progression from one stage to a higher concurrent stage is caused by nutrient enrichment through surface runoff carrying excessive fertilizers from agroecosystems and/or discharged human waste from settlements. Eutrophication is able to be accelerated by human activities around the ecosystem. The rate of nutrient output in water is accelerated by the fast pace of urbanization, industrialization, and high activity of agricultural. All that activity led to loss of dominant species and functional groups, increase in nutrient turnover, high porosity of nutrient and sediment and most important is loss of productivity. (Malone & Newton, 2020). In agricultural areas, inorganic nitrogen and phosphorus are major contributors to the eutrophication. They are most likely found in the fertilizer that is used to make the plant become healthier, greener and have higher production of fruits or vegetables. Eutrophication can make a phenomenon call algae bloom (Kakade, et al., 2021).

Algae bloom is where the algae in the surface of the water is covered and will block the sunlight for the underwater organism to get nutrient from the sunlight. Eventually, when the living organism did not receive specific amount of sunlight, many consequences will happen like the plant will be dead and from the incident, the fish will also obtain less

oxygen and will make the dissolved oxygen in the water will decreased rapidly (Nutrient Pollution, 2023).

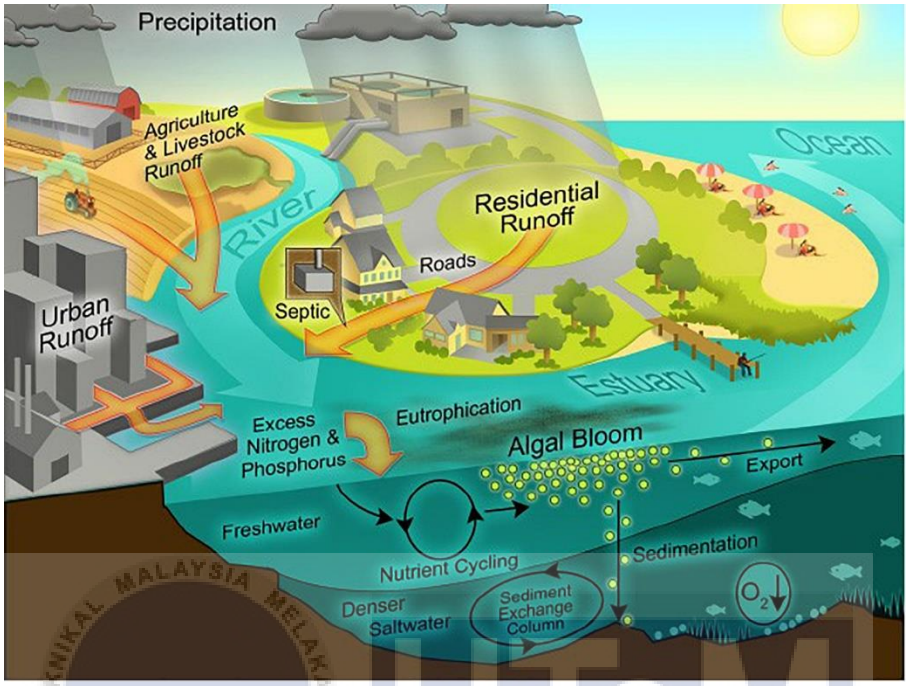

Figure 2.2The euthrophication cycle that cause by human urbanization

Next, water surface contamination can occur naturally, intentionally, or unintentionally. Natural water surface contamination happens due to natural disasters like tsunami or flooding. It happens when there is water from the sea or sky filling up the river. There is almost no conceivable way to control natural occurrences. The flood and tsunami usually pick up the debris and contamination. Besides that, they also collect all the unwanted material like fertilizer, pesticides, and other chemicals. Unintentional is more likely to happen due to some incident or accident by human mistake or other things. Examples like spillage of oil from a ship, boat or from the oil rig. Next, this also might be happened if the agriculture runoff has a problem and cannot contain the flow of the chemical, it might spill to the nearest water source like river or it might go indirectly

through the soil and go into the underground water source. All the cause stated above is uncontrollable because some might happen by mistake (ama, 2020).

Figure 2.3 Oil spill by accident in bangladesh

What is saddest happen is pollution that happen with intention is, it come from human behavior itself. We can see this from the agricultural level where the farmer purposely releases unwanted materials like fertilizer, fungicide, pesticide and many more that contain harmful chemicals for the ricer like sodium, potassium, nitrate and many more. At industrial level or known as factory level there is multiple waste that been dumped into the river. Microfibers, plastic, or non-plastic origin and many more are some examples of industrial waste that been purposely released to the river. The example that been listed out is a physical contamination that able to float (Bashir, et al., 2020). Not to forget about irresponsible human behavior that thrown away the rubbish everywhere until it ends up

into the nearest river. In figure 2.4 shows that the river is full of plastic and metal waste. That incident happens in Kuala Lumpur, Malaysia itself (Balasegaram, 2019).

Figure 2.4Mounts of rubbish trapped in Sungai Gombak in Kuala Lumpur (Balasegaram, 2019).

Next is ground water pollution. Groundwater pollution occurs when unwanted material or material that is supposed not to be on the water is applied to the ground surface by human seep into the ground. Then when raining time, all the unwanted material that contributes to contamination will be absorbed through the ground and goes to underground water sources. All the underground water sources will go to the nearest river and waterbeds.

This phenomenon is called agrochemical. The chemical that pollutes the most is called nitrate. It contains in pesticide, fungicides, herbicide, and other chemicals that are used in agriculture. Those chemicals also might contain carcinogens and other chemicals that are extremely dangerous to fish and other aquatic organisms. When all the material goes to aquatic life, it will indirectly come to a bigger food chain and as we know, humans are the top level in food chain.

According to the World Health Organization (WHO), 80% of world diseases come from the quality of the water that has been drink. There are also more than 50 diseases that

come from poorly treated drinking water. Not to forget, 50% of the children worldwide death reported that are linked by inferior quality of water.

In Malaysia, the quality of river water has a significant impact on human life. Urbanization and modernization in Malaysia cause river water pollution, which harms river water quality in Malaysia. The Department of Environment (DOE) and National Water Quality Standard (NWQS) has released a water quality index (WQI), as shown in Table 2.1, which categorizes into five categories according to the respective National Water Quality Standards (NWQS)

Table 2.1 Water Quality Index by Depart of Enviroment (DOE)

CLASS	USES
Class I	Conservation of natural environment. Water Supply I – Practically no treatment necessary. Fishery I – Very sensitive aquatic species.
Class IIA	Water Supply II – Conventional treatment required. Fishery II – Sensitive aquatic species.
Class IIB	Recreational use with body contact.
Class III	Water Supply III – Extensive treatment required. Fishery III – Common, of economic value and tolerant species; livestock drinking.
Class IV	Irrigation
Class V	None of the above.

The department of environment stated that in annual report of 2017 almost 63.94% of river in Malaysia have been categorized in class II. That is 144 rivers out of 477 rivers. Whereas there other is 30.19% are in the class III level. Most of the major pollutants are biochemical oxygen demand (BOD) from sewage, agricultural activities, farming, ammoniacal nitrogen, manufacturing industries and from domestic sewage. There is also suspended solid that come from the land clearing activities (Anual, 2020). Figure 2.5 shows the data that represent the quality of the river from 2008 to 2017and figure 2.6 shows the river quality status from 2008 to 2017. They represent in 3 categories whether clean, polluted or slightly polluted.

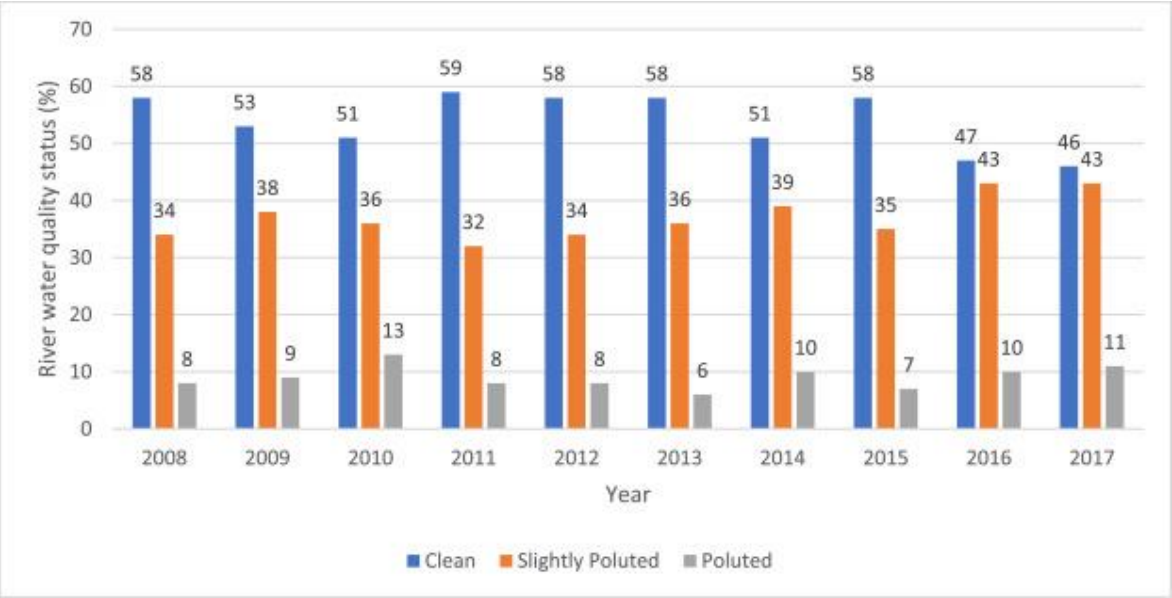

Figure 2.5 River water quality from 2008 to 2017

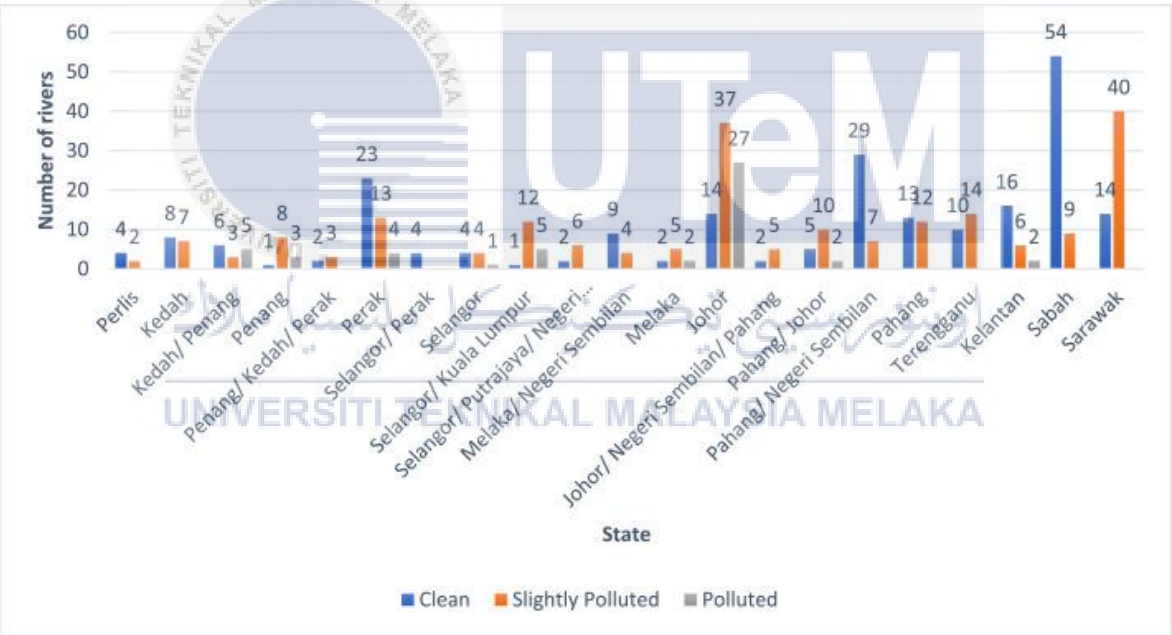

Figure 2.6 River water quality by states from 2008 to 2017

2.2.2 Pollution in Malaysian river

According to Berita Harian in 2019, more than 80 percent of the river in the big city can be categorized as polluted from the industrial waste every year. According to them due

to high volume of civilization, most of the river lost the ability to maintain the ecosystem to supply fresh water, process the sewage system and maintain its productivity.

This is because most of the river is packed with rubbish and unwanted material like plastic, plastic bottle, used tyre and many more. All the rubbish accumulates and makes a small island that turns the river into black water and produces an unpleasant smell. The most polluted river in big city in Malaysia is Sungai Juru in Pulau pinang, Sungai Senggat in Johor and Sungai Klang in Selangor. The saddest thing is the river is located in the big city where the educated person is in high percentage. (Ismadi & Hasan, 2019)

A developing city in Kedah named as Sungai Petani have encountered the issue with polluted river. This problem has been an issue for more than 20 years and keeps worsening every year. It is very concerning because it might affect their health if there is no involvement from responsible authorities. It is stated that the river in Sungai Petani was polluted from the sewage, used oil from the residential area nearby, industry, car workshop and from the stall near the river.

Figure 2.7 Water pollution at Sungai Petani, Kedah

Next, almost every year we can hear that a state in Malaysia have encounter an issue with pollution. Sungai Klang in Selangor was polluted until it affected 300,000 users of the river from few districts like Petaling, Hulu Langat, Kuala Langat dan Sepang. Two of the water treatment along Sungai klang have to shut down immediately due to water

pollutant at the river. That make the clean water supply need to be stop channeled to nearby user (malaysiakini, 2020). In 2020, Selangor have been facing water pollution nine times in a year. Many cases of pollution have been reported including oil spillage, solvent spill, and chemical spill. The local authority has to make an act to impose action on the irresponsible parties. (Sorotan 2020: Selangor Hadapi Sembilan kali pencemaran air - berita harian, 2020)

Figure 2.8A local resident have to gain clean water from public faucet. (Sorotan 2020: Selangor Hadapi Sembilan kali pencemaran air - berita harian, 2020)

In Sungai Melaka, the main cause of water pollution is from the human activities nearby. Many activities had been held near the river such as restaurant on top of the river, shopping at the stall nearby, goes to heritage place, museum, and many more activities can be done there. But the most leading contributions is boat cruising along the Melaka river at the slow pace. It is become a problem for the goverment, local and most effected is the tourist that come to visit Melaka river. Based on Department of Enviroment (DOE) Malaysia, Sungai Melaka have been categorized as Class IIA and Class IIB (DOE, 2021) . The reading that been gained is gathered from the monitoring station that located at the upstream of Sungai Melaka. The location of water monitoring is located at Sungai Tampin, Sungai Dusun and Sungai Kemunting. The reading of the river is not innvolved with the

activities near the downstream where high-density residental, sewage treatement plants, comercial lots, heavy industrial zone is contribute to pollution.

Table 2.2 A section from DOE report in Sungai Melaka

Sg. Melaka	Sg. Tampin	1	89	B/C	II	86	B/C	II
	Sg. Batang Melaka	2	81	B/C	II	81	B/C	II
	Sg. Dusun	1	80	ST/SP	II	86	B/C	II
	Sg. Kemunting	1	81	B/C	II	85	B/C	II

There are many other factor that contribute the pollution in Sungai Melaka, some of the reason is from the waste pollutant and excretion waste. It is able to cause contamination and brings down the quality of the water quality. The resident area in Alor Gajah, Melaka Sentral and the state goverment have support the issue that the water quality of the river had been decreased dramatically because of the pollutant. A few acts had been enforced to avoid any foreign material from entering the river without permission, increase sewage treatment and to maintain water quality service. The acts that been enforced is Water Acts 1920, Sewage Service acts 1993, and Industrial Effluent 1979.

Many action have been taken by the state goverment to solve the issue on Sungai Melaka. In 2005, Perbadanan Pembangunan Sungai Dan Pantai Melaka (PPSPM) have been established by the state goverment. PPSPM are responsible to preserve the rivers and beaches found in the state of Malacca. They are also have a lot of CSR activities involving comunity and NGOs such as Hard Rock cafe and Universiti Teknikal Malaysia Melaka (UTEM) , it will float. If an object displaces less fluid than its own weight, it will sink.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter presented all the methods that were used to design and complete this final year project in a systematic and comprehensive manner. Several methodologies and research instruments have been employed to make progress on this project throughout its duration. The procedures or methods that are followed to complete the project in its totality are referred to as methodology. This process is important in the project's implementation since it ensures that the project is completed successfully and on time.

3.2 Project Flow

Project flow is a graphical representation of a project's lifecycle that combines a flowchart and a Gantt chart. It provides a detailed and visual depiction of the project's processes, tasks, and timelines. Both flow chart and gantt chart are crucial to a project.

The combination of a flowchart and a Gantt chart in a project flow provides a holistic understanding of the project, allowing for effective planning, monitoring, and control. It aids in visualizing the logical sequence of activities and their corresponding timelines, enabling project stakeholders to manage resources efficiently and ensure the project progresses smoothly and on schedule.

3.2.1 Flow chart

A flow chart is a simple visual representation of a series of steps, with shapes and arrows showing the progression's direction. A flowchart depicts the individual steps of a process in a logical order. It is a generic tool that be used for a wide range of purposes and

can be used to describe a number of processes, including manufacturing, administrative and service processes, and project plans. Flow chart is a key tool to see the complex system work which helps the researcher to solve the problem in the process and analyzed it to get the solution. In this report, the flow chart is used to monitor and express the process in order for the work to finish smoothly. Figure **3.1** shows the flow chart for this project.

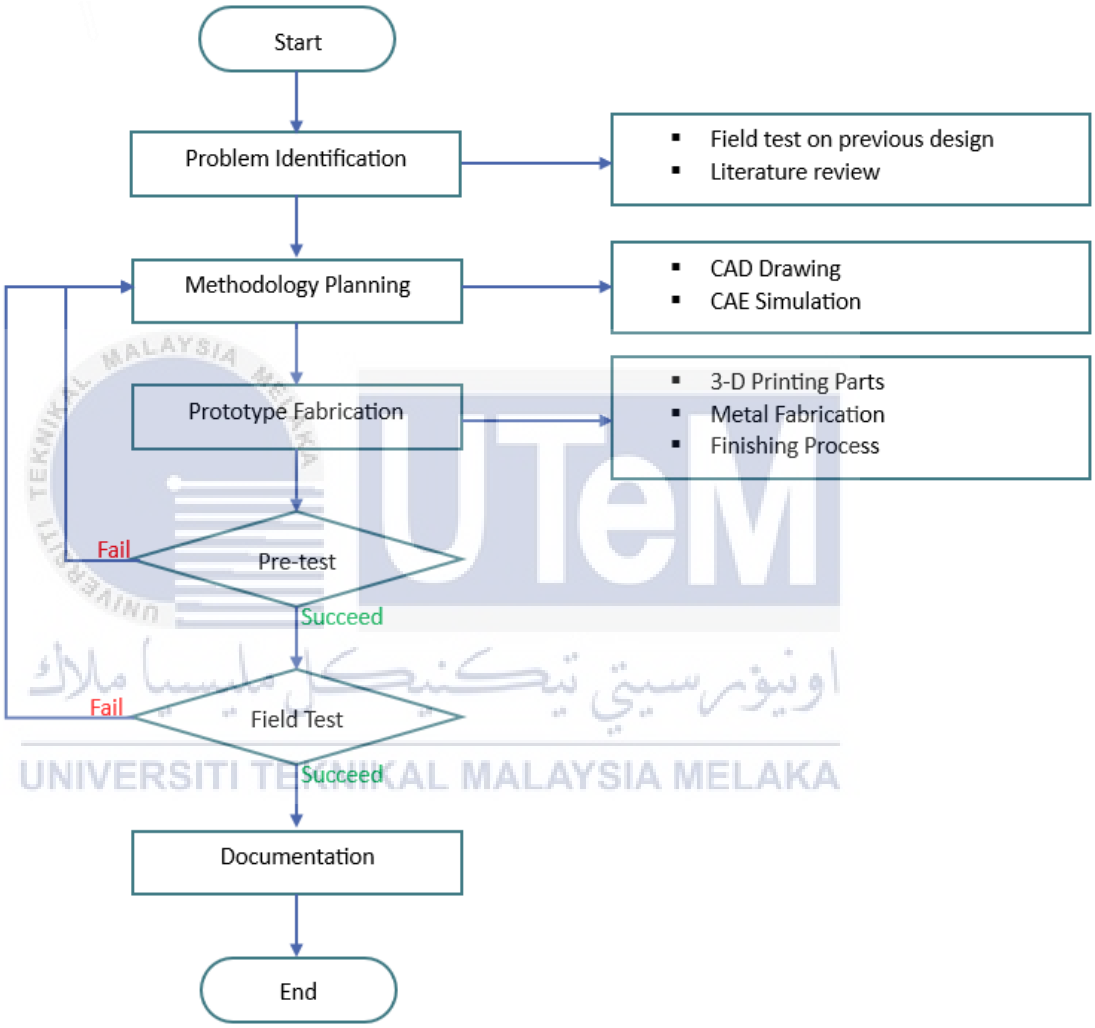

Figure 3.1 Flowchart

3.2.2 Gantt chart

A project plan, also known as a project management plan really need a gantt chart to coordinate the time and to avoid any delay that may happen if its unplanned. In the gantt chart, a list of the activities may be found on the left side of the chart, and a suitable time

scale can be found along the top. Each action is represented by a bar, whose location and length indicate the activity's start, duration, and end dates. The Gantt chart approved at the start of the project and then modified as needed throughout its duration. A Gantt chart is a project management tool that can help with the planning and scheduling of projects of all kinds, but it's especially beneficial for simplifying complex tasks.

The Gantt chart for this project shows on each task has been recorded for this project progress. The timeline should be realistic as it is will shows an important date such as submission report and presentation PSM 1 and PSM 2. This project has been planned for 12 months from Febuary 2023 until January 2024 to accomplish this project that cover semester 1 and semester 2. To start this project, we must planning all the detail that are necessary for the project to succed.

The high-level activities will be identify and then break it into smaller subtopic. This will shows how much task that we need to do to complete this project. The Gantt chart is created using MS Excel as it is easier and faster to create and we can easily understanding it. For the detailed of the Gantt chart, it can be refer at the Appendix A for PSM 1 and appendix B for PSM 2 .

3.3 Previous HydroQS testing

On previous HydroQS, a tested was made at the sungai melaka specifically located at taman rempah. A fabrication on previous was made to be seen the problem more clearly. After the HydroQS was placed, few problem can be seen. The problem that was found is

the HydroQS drifted away from the location and the HydroQS was unable to withstand the stern wave that come from the engine boat that cruising at Melaka river

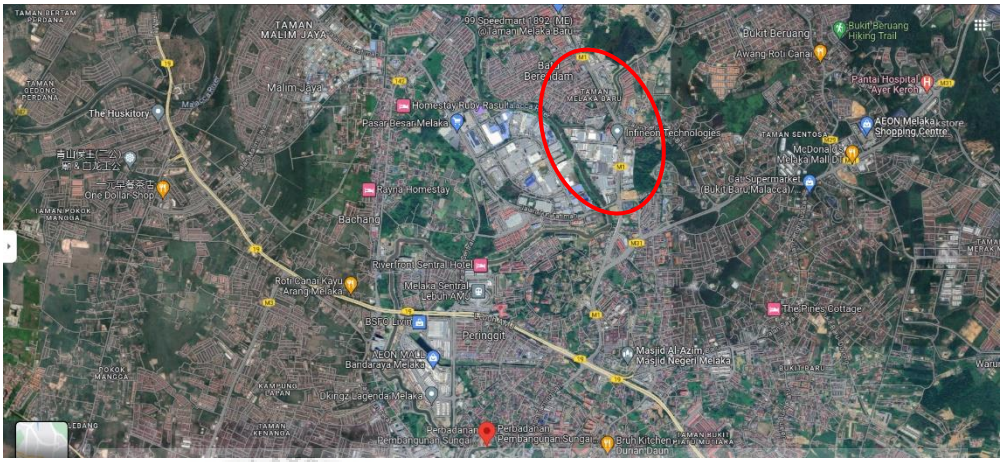

Figure 3.2 Location of HydroQS placement and the industrial areas

3.4 Product improvement

To encounter problem that been found, a rig was made to hold the HydroQS. The idea is was made by using a high number of joint such in figure 3.3, but the problem with the original idea of rig is it is very heavy on the alumium part and it have a much more

degree of freedom that would increase the load and would drag down the HydroQS into the river.

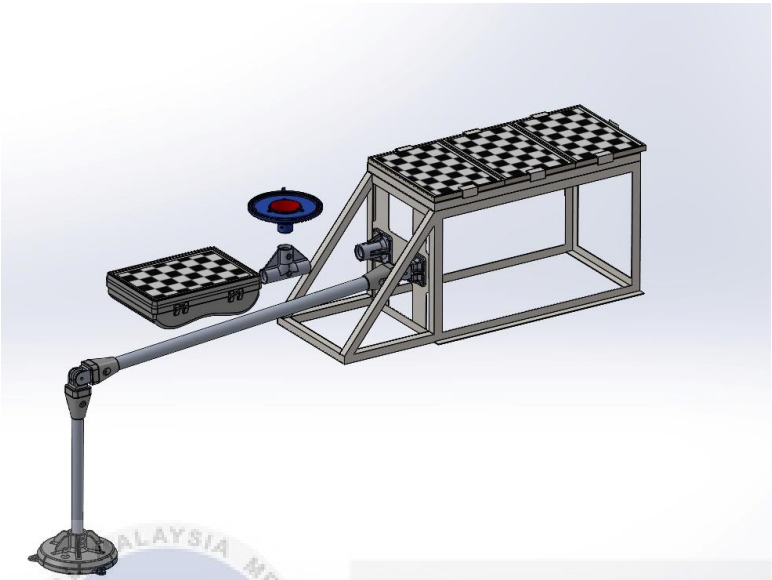

Figure 3.3 First rig design

An improvement was made to reduce the degree of freedom. A concept of holder like figure 3.3 was designed. The solar panel was changed places from the HydroQS body

into the rig. A single aluminium round pipe was attached on top as a holder to main body of HydroQS

Figure 3.4 Second Rig design

3.5 Simulation

In this project, the rig was simulated to enhance the strenght of the structure and to determine the maximum strenght, factor of safety, elongation and many more. It was able to help to prevent the rig from any problem that would happen during the application. The simulation software that we use is by using solidwork from dassault system.

3.6 Fabrication technique for HydroQS Rig

HydroQS rig is made from metal to ensure the maximum strenght. For the metal joining technique, a welding was used to joined between each of the metal. The technique

that was used is butt joined and tee joined. The welding was using a Metal Inert Gases (MIG) welding as it was suitable for hollow metal.

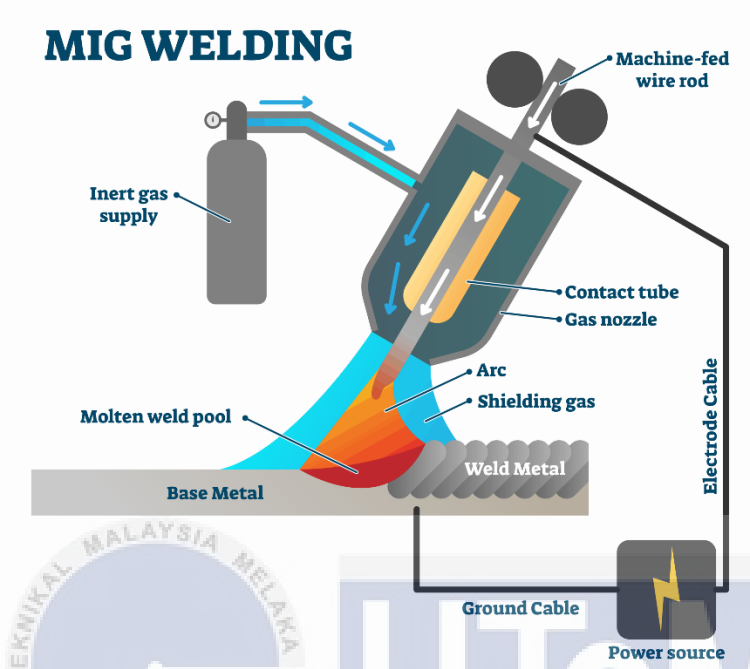

Figure 3.5 MIG Welding Process

Next, to ensure the surface is cleared from welding seams, a grinder was used to cleared out the welding seams. The welding seams are not preventable, thus it need to be removed. A metal flap disc from bosch such in figure 3.7 was used to attached with the grinder.

Figure 3.6 Angle Grinder

Figure 3.7 Angle Disc Cutter

For the finishing, 3 layer of painting was applied in order to ensure the finishing surface is in good condition and to prevent air from entering and penetrate the metal parts. Any exposure of metal into open air would have a reaction between metal and water molecule that included into air. To prevent that, an undercoat is needed to ensure good adhesion between top layer and the metal. For the top layer, a spray painting technique was applied to have uniform layer painting surface. lastly, a lacquer painting is used to embrace the colour of the painting.

3.7 Fabrication of previous HydroQS

to identify previous problem, previous HydroQS need to be refabricated. The process of fabrication need to made. Since the HydroQS are mostly made from 3-D printed part. Most of the process are related to 3-D printing. It is starting from pouring the SLS powder into the siever (A). Next, the clean powder were poured into mixer to ensure there powder is well blended (B). After all of that was blended, the powder must be poured into the machine (C).

Next, the powder must be poured into Next, the part was set to printer and ready to be printed (D). The file was inserted into the computer and must be waited for 3 days (E). After the part was printed, the part was such in a cake form (F). Next, the powder was

cleared of the excess part (G) and the powder that sticked into it was brushed off (H). all the part was cleaned by using sand blasting machine(I). Lastly the part was cleared from the powder(J). a layer of surface filler was place as an surface treatment to prevent the water from entering the body of the HydroQS (K). The part was let dry for 24 hours (L) and finishing process such as painting (M) was made. Then, the part was let dry for a day to ensure the part was totally dry(N). after that, all parts was assembled such as sensor, aluminum part, acrylic part and others(O). next, the part was tested in a bucket to ensure the main body is waterproof (P). After that, it was tested into the large basin to test the buoyancy of the buoy (Q). after that, HydroQS was placed into jeti taman rempah. The part was attached with a string to ensure it was not drifted away.

Figure 3.8 Fabrication Process of Previous HydroQS

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, it will show HydroQS device works in Sungai Melaka without it drifted away. Analysis of the strength of the rig and tested that been made to ensure the HydroQS will stay float on its position.

4.2 Testing result of HydroQS Holder

After previous fabrication of HydroQS have been made, it have been monitored for a few hours. The result shows that the previous HydroQS was able to float successfully until a river cruise boat was go through Sungai melaka. The stern wave from the boat make the previous HydroQS flipped and makes the previous HydroQS full submerged into the water. One of the reason for this is that the previous HydroQS was having an unbalanced load where the heavy load such as battery and solar panel was placed on top. The load on top cause the HydroQS been dragged down and stumbled.

4.3 HydroQS Holder

After the incident of previous HydroQS was sunken and submerged into the river. It have been found out that the HydroQS need a holder to keep it upright. The holder also use to lessen the load on the HydroQS by removing electric and electronic appliances inside and placed it on the outside. The electronic component such as battery, router, electronic board and some other thing was placed into a box and attached on the back of the holder. The camera from the body was placed into a holder to get a better view on overall. Next,

the solar panel were placed into the middle of the holder to achieve maximum absorption of energy from the sunlight.

A stand was made as a support to increase the support on the front load. The support were placed right before the edge of Sungai Melaka river bank. The load was attached to the front where the holder is having a ring type that allow the tube that located in front to have a free-play as the water in the river ebb and flow. Figure 4.1 show the placement of component of the attachment

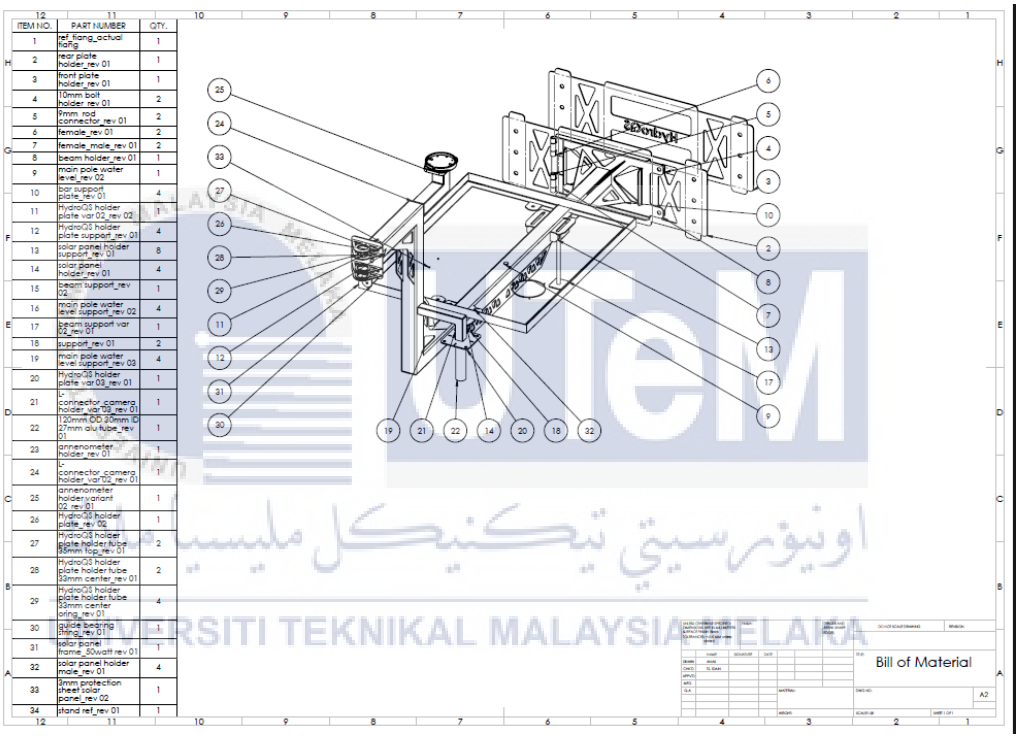

Figure 4.1 Placement of electronic attachment

The length of the HydroQS holder is 1.45m from the place where its attached to it place. The total height of the Simulation of HydroQS holder is 0.809m from the ground.

The height was elevated to make the maintenance and the installation easier. The detail of the drawing is located in appendices C

4.4 Simulation of HydroQS holder

Before a simulation was started, few perimeter need to be set. One of it is to set the fixture. For the structure, 2 fixture was set to hold the structure. The first one to be set at base or can be called as leg and the second one is placed on the ground where the HydroQS was attached into the it.

Figure 4.2 Fixture Location

Next, is the placement of the load. This is very important to determine the load direction and quantity. For this structure, the load was placed on top of the end of the structure where the load is placed. The force that was applied is 200 Newton. This is

equivalent to 20.18Kg. The load was calculated by using the earth constant gravity that is 9.81m/s

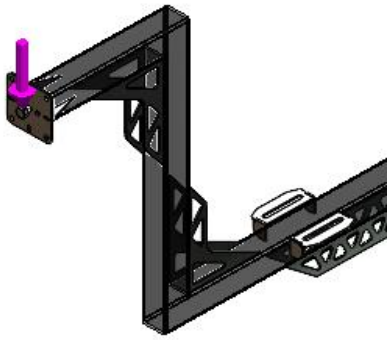

Figure 4.3 Placement of Forces

Before finite element analysis was carried out, the solid body need to be meshed so the computer are able to calculate it. For this project, a mixed mesh was used and it was a blended curvature-based mesh to obtain the best result. It also was set to be in a high mesh quality to create the best and most accurate mesh result.

Table 4.1 Mesh Table

Mesh type	Mixed Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Jacobian check for shell	On
Maximum element size	175.189 mm
Minimum element size	8.75943 mm
Mesh Quality	High
Remesh failed parts independently	Off

4.4.1 Improvement of Hydroqs holder

A holder need to have a great strength in order to prevent something from happening such in a bad way. The original holder have a low factor of safety such in figure 4.4. It have a factor of safety of 1.4 that means it was able to withstand 280N before its start to fail.

The design was improved by adding a support below the holder. Thus, the minimum factor of safety goes up until 7. That is mean that the holder are able to hold up to 140N without any failure.

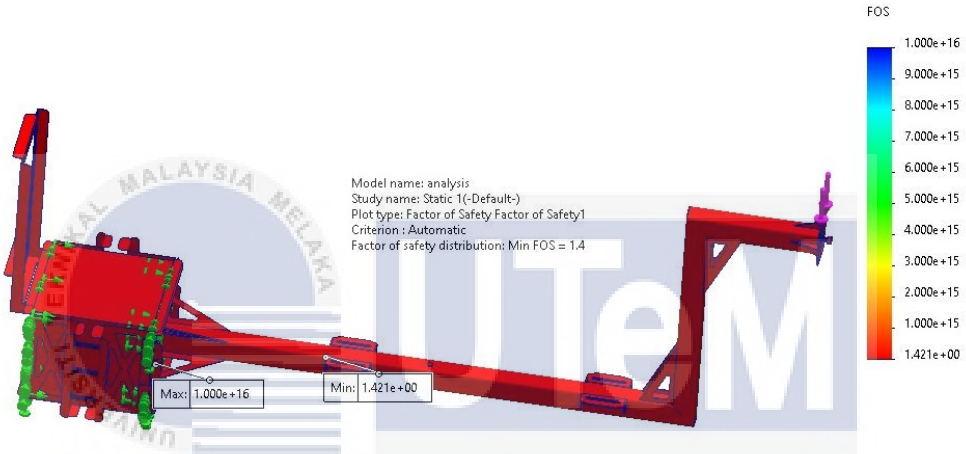

Figure 4.4 FoS result in Solidworks before improvement

4.4.2 Result of von misses stress

The result from the simulation shows that the maximum stress that could be loaded in this structure is 9.992e+07 N/m^2 or in simplified form is 99,920,000 N/m^2.

Name	Type	Min	Max
Stress1	VON: von Mises Stress	0.000e+00N/m^2 Node: 12403	9.992e+07N/m^2 Node: 20542

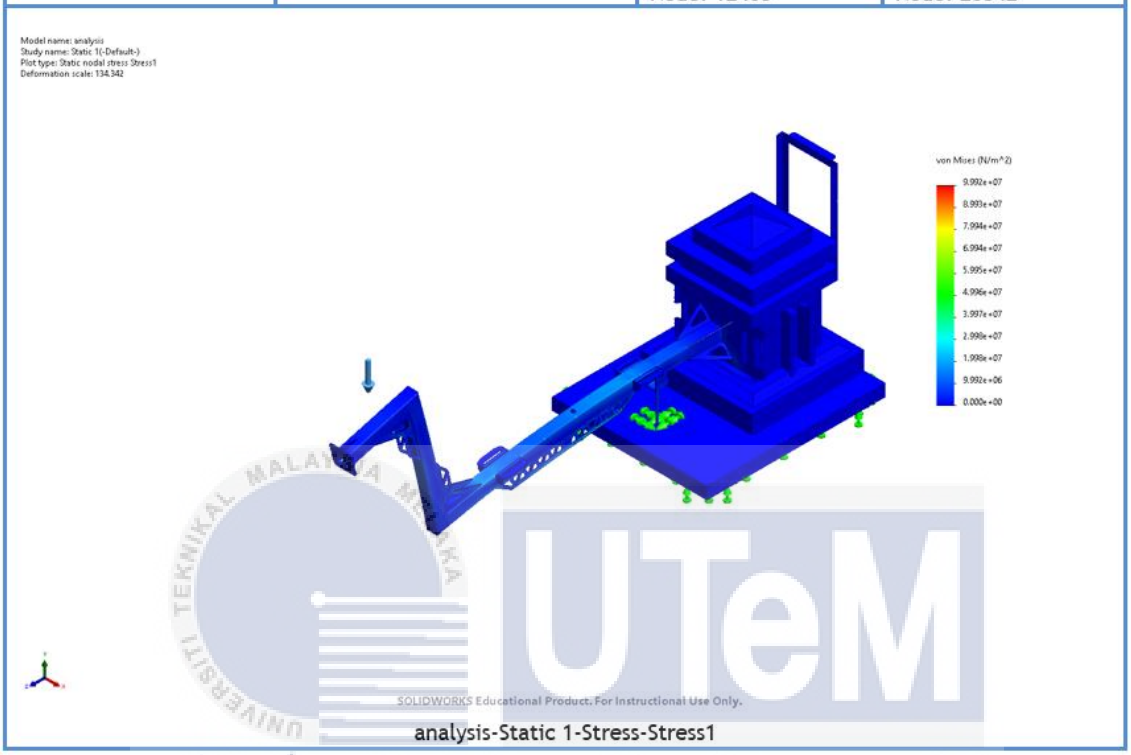

Figure 4.5 Simulation result:Von Mises Stress

4.4.3 Result of strain

The result of strain is to determine the amount of the structure displace or bending distance from the original position. For the strain of this structure, it gain of maximum of 1.688 mm from the original position. By the visual, 1.688 mm is not very visible by eyes. This is why we need to simulate a product before it was fabricated.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 12403	1.688e+00mm Node: 12882

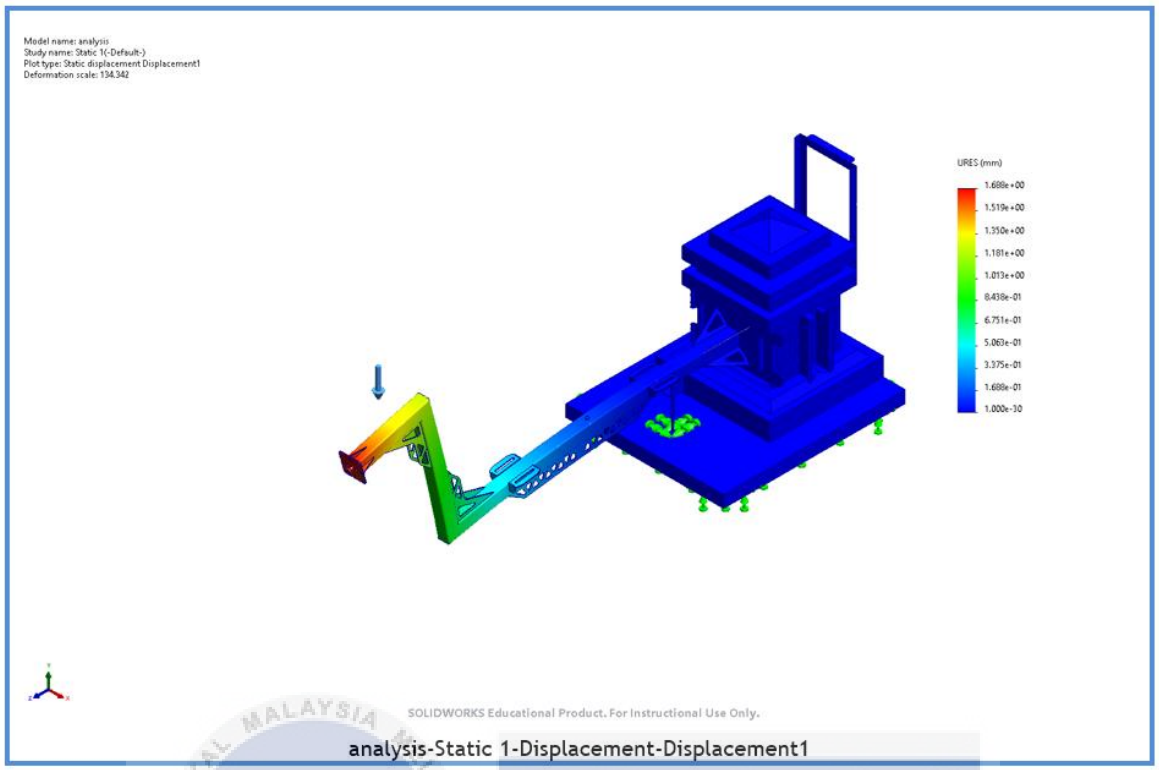

Figure 4.6 Simulation result: Resultant Distance

4.4.4 Result of factor of safety

For the factor of safety, the minimum factor of safety for this structure is 7.007. this means that the structure are able to withstand the 7 time the force that was placed. 7 times of the force means it able to withstand 1400N without having any issue.

Name	Type	Min	Max
Factor of Safety1	Automatic	7.007e+00 Node: 89319	1.000e+16 Node: 12403

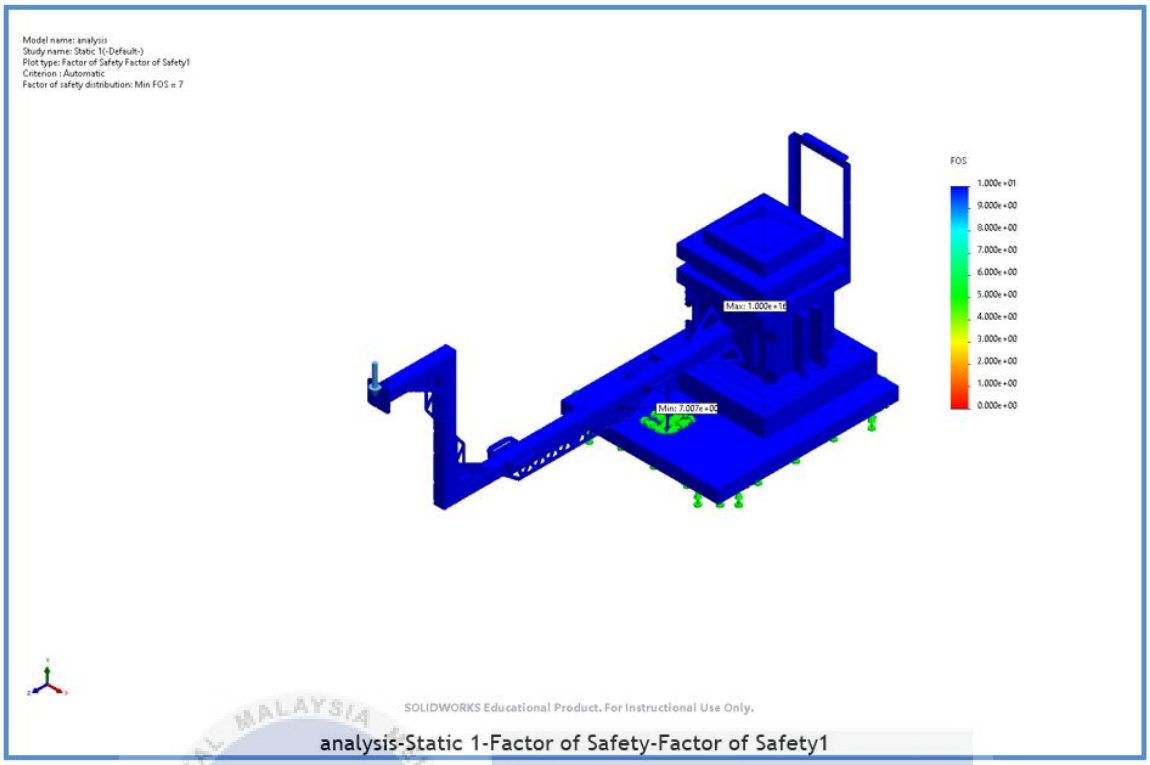

Figure 4.7 Simulation result: Factor of Safety

4.5 Fabrication of HydroQS holder

After the simulation, a fabrication was made. It is started with finding the correct material that was designed. After the material was selected, the material was measured into the length and was cut. The material that been use is square bar. Some of the part was fabricated by using sheet metal. The sheet metal that been used have a thickness of 5mm. the sheet metal was cut by using laser cutting to gain high precision and good finishing. It also helped to cut metal that have complicated part. Then, the material was welded edge to edge to prevent air from entering the hollow part of the material. Next, after welding the square bar and the laser cut part, the excess metal from the welding was grinded to make the surface flatten and seamless. Next, the part was placed into an undercoat to ensure the

surface having good adhesion between the surface of metal and the top layer coating. Then, the paint was let dry for a day and the top layer coating was placed.

4.5.1 Pre-Test

After the paint was been dried, all the attachment were placed onto it such as solar panel, camera, electrical compartments and others. The whole assembled part was placed in front of the SLS lab to check the functionality of the others component. The next reason to pre test is to ensure that there is no crack in the weld joint and to ensure that all the parts were able to function properly without any failure. The pre-test was carried out for a week and no abnormalities was found.

Figure 4.8 Pre Test in front of SLS lab

4.5.2 Field Test

After the pre test, the holder was install to Sungai Melaka. The installation is started from the installation of the solar panel bracket. Then, the solar panel was install and secured with a screw. After that, the HydroQS holder was attached into Sungai melaka river bank.

After that, a pole that suppose to hold the HydroQS holder was install to the front. Next, the HydroQS was installed to end of the pole. The installation need to use a boat to make the installation easier. Lastly, all the screw in HydroQS and its holder was tighten at as maximum as it can be.

After the installation, a high speed boat was used to run nearby the HydroQS. The boat was running at the maximum speed back and forth. The stern wave created from the boat is consider as high stern wave because the boat are moving at the maximum speed. As a result, the HydroQS was able to float without any problem

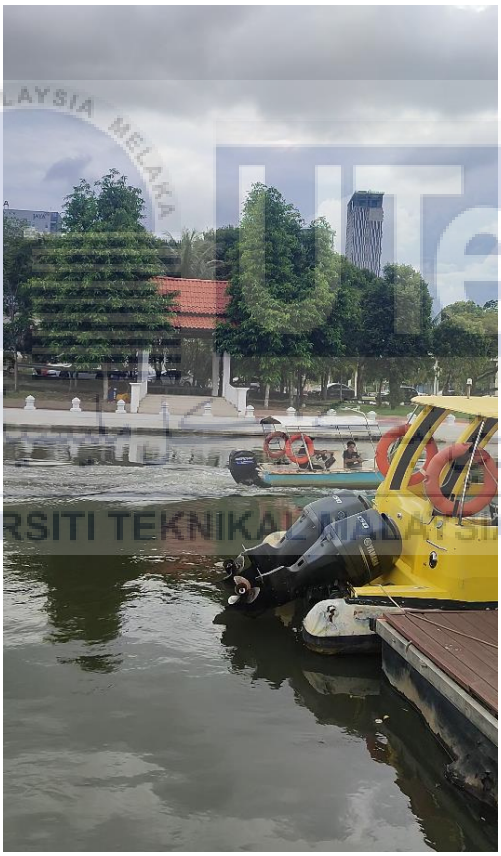

Figure 4.9 Testing HydroQS with a high speed boat

After the installation was complete, it was monitored for a few hours to see the abnormalities. The HydroQS were successfully float into the Melaka river without any abnormalities. A continous monitoring from day to day was made to monitor the abnormalities and no abnormalities was found.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter introduces the project's conclusion and outcomes. Some recommendations will be made based on the findings, depending on the limitations and future improvements

5.2 Conclusion

Overall, the aim of this project is to improve the design of the HydroQS. All of the objective are well achieved. The first one is To conduct a design study on previous HydroQS. The next one To improve previous design of HydroQS and To fabricate HydroQS Holder

In this study, reverse engineering is used to determine and identify the weakness of the previous HydroQS. It is a good method to determine the weakness of a product. Next, a simulation were also help the engineering industry to determine the maximum strenght of a product. In this project, the holder was designed to achieve FoS more than 7. this was made to avoid any disruption or any excessive load from affecting the holder

Lastly, any part that need to be used, a testing is needed to ensure the smoothness of the operation. From this project, it was tested 3 times, the first one is from the simulation.

The next one is from the pre-test where the part was tested in the lab and lastly the part was tested in the river itself.

5.3 Recommendations

The recomendation for this project is to improve on the tube holder where the tube was attached inside of the ring. The concept of holder that use a ring type is it have high friction area. To improve this, a bearing suppose to added to smoothen the movement of up and down.

Figure 5.1 Holder of the tube

Next, the solar panel are recomended to added aditional solar panel. This is because during northeast monsoon season that happen from october until march, the pattern of the

cloud in Melaka are cloudy most of the time, this might affect the power supply to the HydroQS.

5.4 Product potential

This project is having a high potential to be installed at other river in Malaysia. River that are polluted are encouraged to install the HydroQS . this is because some of the Malaysian river is polluted on the inside but unable to be detected with the naked eye. Some of the suggested river that should be install this project is sungai kim-kim, sungai petani, sungai klang and many others polluted river.

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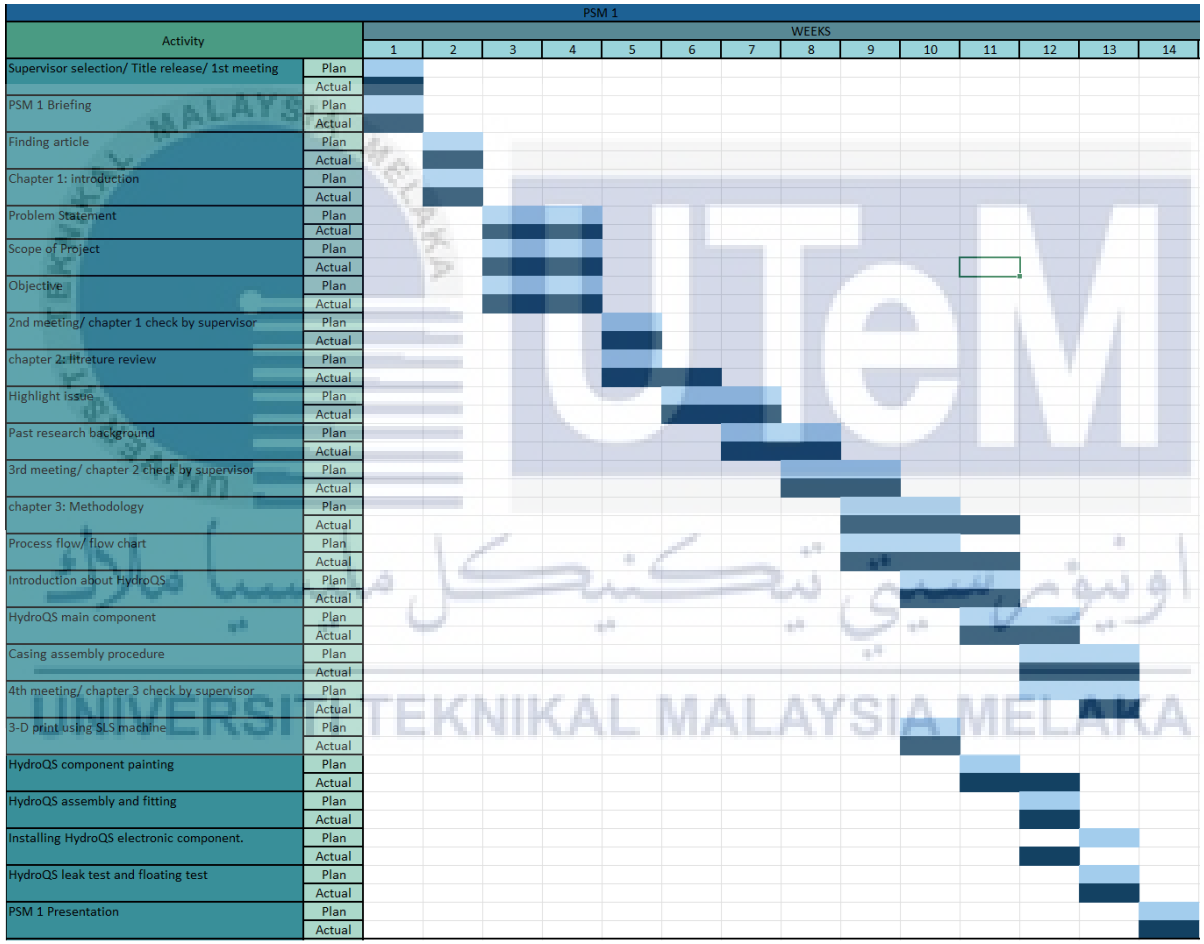
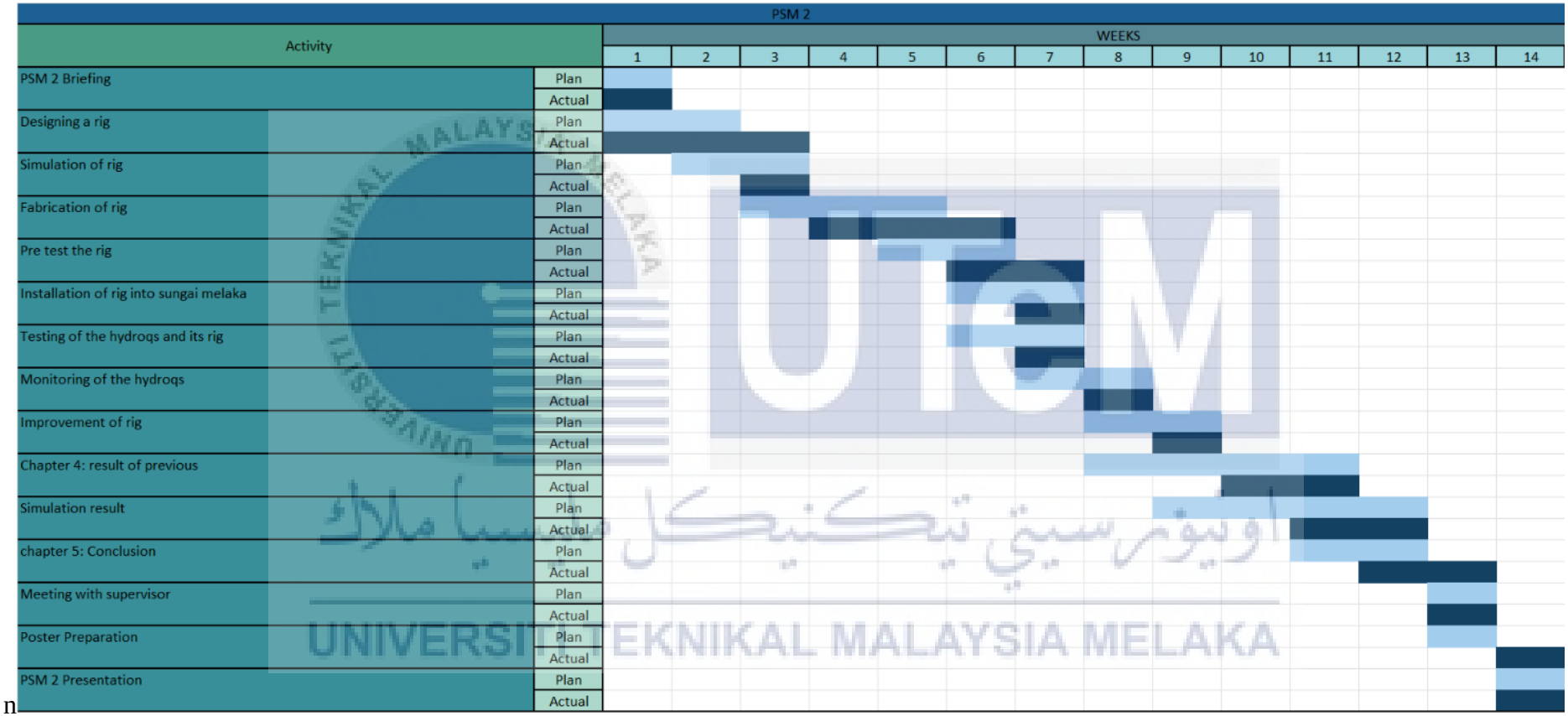
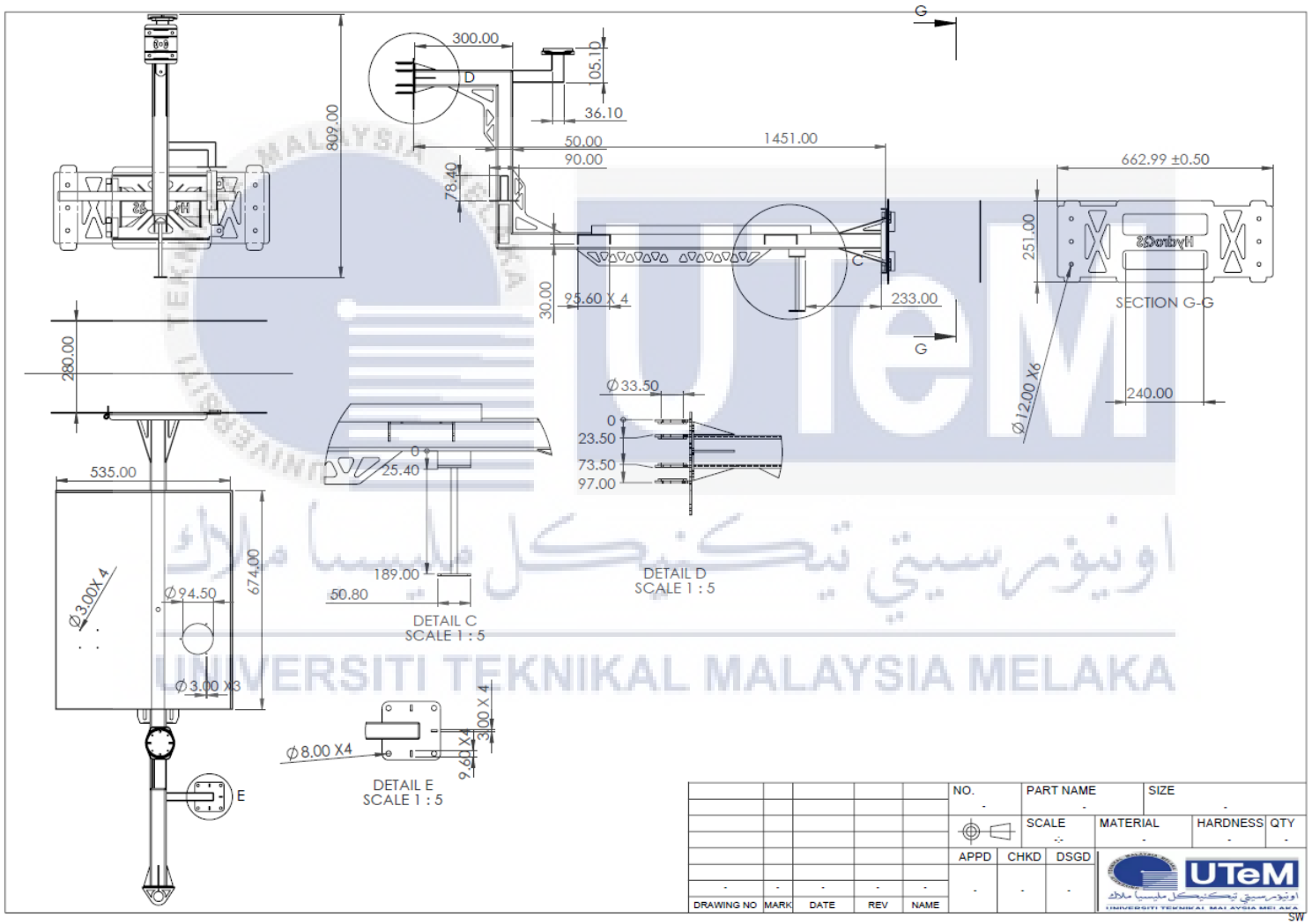
APPENDICES A: Gantt Chart Psm 1



APPENDICES B: Gantt Chart PSM 2



APPENDICES C: HydroQS Holder Drawing



APPENDICES D: Report Originality

ANAS_B092010256_PSM2_BMMD_TURNITIN_REPORT

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19%	12%	4%	16%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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APPENDICES E: Thesis Validation

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA

TAJUK: **DESIGN IMPROVEMENT OF HYDRO QUALITY MONITORING SYSTEM**

SESI PENGAJIAN: **2023/24**

Saya **ANAS BIN ABDUL MALIK**

mengaku membenarkan tesis ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)
☑	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	TIDAK TERHAD	

Disahkan oleh:

Alamat Tetap:
2516 C-10, FLAT KOPERASI,
SUNGAI GELUGOR, 11700,
GELUGOR, PULAU PINANG

Tarikh: 2/2/2024

Cop Rasmi: TS. MAZRAN BIN AHMAD
Jurutera Pengajar
Jabatan Teknologi Kejuruteraan Pembuatan
Fakulti Teknologi Kejuruteraan Mekanikal dan Pembuatan
Universiti Teknikal Malaysia Melaka

Tarikh: 31/1/2024

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

APPENDICES F: Thesis Clasification Report

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Rujukan Kami (Our Ref):
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Tuan

PENGKELASAN TESIS SEBAGAI TERHAD BAGI TESIS PROJEK SARJANA MUDA

Dengan segala hormatnya merujuk kepada perkara di atas.

2. Dengan ini, dimaklumkan permohonan pengkelasan tesis yang dilampirkan sebagai TERHAD untuk tempoh **LIMA** tahun dari tarikh surat ini. Butiran lanjut laporan PSM tersebut adalah seperti berikut:

Nama pelajar: ANAS BIN ABDUL MALIK (B092010256)
Tajuk Tesis: DESIGN IMPROVEMENT OF HYDRO QUALITY MONITORING SYSTEM

3. Hal ini adalah kerana IANYA MERUPAKAN PROJEK YANG DITAJA OLEH SYARIKAT LUAR DAN HASIL KAJIANNYA ADALAH SULIT.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"
"KOMPETENSI TERAS KEGEMILANGAN"

Saya yang menjalankan amanah,

MAZRAN BIN AHMAD

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