UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND FABRICATION OF GREENHOUSE'S GUTTER HOLDER FOR G.I. PIPE FRAME STRUCTURE

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A thesis submitted
in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this Choose an item. entitled “Design and Fabrication of Greenhouse’s Gutter Holder for g.i. Pipe Frame Structure” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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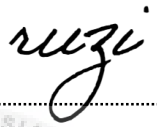
APPROVAL

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 Mechanical Engineering Technology with Honours.

Signature : 

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Date : 20/1/2023

DEDICATION

In the name of Allah, the Entirely Merciful and The Bestower of Mercy and with deep appreciation to the Prophet Muhammad S.A.W. I did the task successfully without any complication faced. I finished this project within the allotted time and to the best of my ability.

To express my gratitude and appreciation to both of my parents which is Nurul Wahidah Binti Abdullah, as my mother and my father Murad Bin Hussin, for their endless support throughout this process.

ABSTRACT

The greenhouse is primarily made of transparent materials, such glass. A plant that needs carefully regulated climatic conditions is grown in the greenhouse. There is a catchment system, also known as a rainwater collection system, at a greenhouse system. The world's oldest way of supplying water is probably rainwater harvesting (RWH). The rain gutter is used as part of the catchment system to collect rainwater. The side of the roof structure is often where the rain gutter is installed. This is due to the fact that installing at the side of the roof is the best location to collect rainwater. This research aims is to design a new gutter a)holder on pipe structure frame using a Solidwoks software. A bracket known as a gutter holder is used to support the gutter drainage system. This gutter holder is the most popular piece of hardware for attaching the gutter to the roof fascia. Gutter holder giving the structural integrity of the building support, stability, and safety. Instead of being merely affixed to the roof, the rain gutter is supported by a gutter holder that is attached to it. An iron alloy that resists corrosion is called stainless steel. Stainless steel is a material that solves the corrosion issue with mild steel. Additionally, stainless steel is inert and environmentally safe, and its endurance ensures that it meets the needs of long-term construction. Additionally, it does not leach molecules that could cause corrosion when it comes into contact with substances like water. The six-design method was employed to create the new gutter holder specialist for the pipe frame structure in order to produce the finest design possible. To complete the fabrication for this project, seven key procedures must be followed: material inspection, material preparation, measuring and marking, cutting and drilling, visual and dimension inspection, final inspection, testing, and finally receiving the results. The gutter holder design results that was using a static analysis from solidworks simulation to get the results. For the design of gutter holders, static analysis was performed on two distinct materials, mild steel and stainless steel. The analyses included stress, strain, and a factor of safety. They can identify whether one component has a tight connection to material breakdown and are fundamentally stable. The parameters utilised to specify the failure criterion and behaviour of a material are stress, strain, and safety considerations.Stainless steel material has been chosen as the main material for the gutter holder. Last but not least, the research must be continued for further study to get more accurate result duirng operation.

ABSTRAK

Rumah hijau terutamanya diperbuat daripada bahan lutsinar, seperti kaca. Tumbuhan yang memerlukan keadaan iklim yang dikawal dengan teliti ditanam di rumah hijau. Terdapat sistem tadahan, juga dikenali sebagai sistem pengumpulan air hujan, di sistem rumah hijau. Cara membekalkan air tertua di dunia mungkin ialah penuaian air hujan (RWH). Longkang hujan digunakan sebagai sebahagian daripada sistem tadahan untuk mengumpul air hujan. Bahagian tepi struktur bumbung selalunya di mana longkang hujan dipasang. Ini berikutan pemasangan di bahagian tepi bumbung adalah lokasi terbaik untuk mengumpul air hujan. Penyelidikan ini bertujuan untuk mereka bentuk longkang pemegang baru pada rangka struktur paip menggunakan perisian Solidwoks. Pendakap yang dikenali sebagai pemegang longkang digunakan untuk menyokong sistem saliran longkang. Pemegang longkang ini adalah perkakasan paling popular untuk memasang longkang pada fasia bumbung. Pemegang longkang memberikan integriti struktur sokongan, kestabilan dan keselamatan bangunan. Daripada hanya dilekatkan pada bumbung, longkang hujan disokong oleh pemegang longkang yang dilekatkan padanya. Aloi besi yang tahan kakisan dipanggil keluli tahan karat. Keluli tahan karat adalah bahan yang menyelesaikan masalah kakisan dengan keluli lembut. Selain itu, keluli tahan karat adalah lengai dan selamat terhadap alam sekitar, dan ketahanannya memastikan ia memenuhi keperluan pembinaan jangka panjang. Selain itu, ia tidak mencairkan molekul yang boleh menyebabkan kakisan apabila ia bersentuhan dengan bahan seperti air. Kaedah enam reka bentuk digunakan untuk mencipta pakar pemegang longkang baharu untuk struktur rangka paip bagi menghasilkan reka bentuk terbaik yang mungkin. Untuk melengkapkan fabrikasi untuk projek ini, tujuh prosedur utama mesti diikuti: pemeriksaan bahan, penyediaan bahan, pengukuran dan penandaan, pemotongan dan penggerudian, pemeriksaan visual dan dimensi, pemeriksaan akhir, ujian, dan akhirnya menerima keputusan. Hasil reka bentuk pemegang longkang yang menggunakan analisis statik daripada simulasi solidworks untuk mendapatkan keputusan. Untuk reka bentuk pemegang longkang, analisis statik dilakukan pada dua bahan berbeza, keluli lembut dan keluli tahan karat. Analisis termasuk tekanan, ketegangan, dan faktor keselamatan. Mereka boleh mengenal pasti sama ada satu komponen mempunyai sambungan yang ketat kepada pecahan bahan dan pada asasnya stabil. Parameter yang digunakan untuk menentukan kriteria kegagalan dan kelakuan sesuatu bahan ialah tegasan, terikan, dan pertimbangan keselamatan.Bahan keluli tahan karat telah dipilih sebagai bahan utama untuk pemegang longkang. Akhir sekali, penyelidikan mesti diteruskan untuk kajian lanjut bagi mendapatkan hasil yang lebih tepat semasa operasi.

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LIST OF SYMBOLS AND ABBREVIATIONS

N/m^2	-	Newton per square meter
mm	-	milimeters
3D	-	3 Dimension
2D	-	2 Dimension
g.i	-	Galvanised iron
%	-	Percent
°C	-	Degree celcius

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

The greenhouse is mostly constructed with transparent material such as glass. In the greenhouse contains a plant which is require controlled climatic conditions are cultivated. At greenhouse system there is a system to collect rainwater to store it which is called catchment system. Rainwater harvesting (RWH) is perhaps the oldest method of meeting water supply demands in the globe (Campisano et al., 2017). The catchment system main objective is to collect the rainwater from the greenhouse. This collecting rainwater construction is not just only a cost-effective, it also a good help of watering the plants. Rainwater collection is a useful management technique that might be utilized to store the water in a reservoir on the farm (OFR)(Deo et al., 2022). Apart from just a ecologically friendly, there is more others reasons why the rainwater is better than the tap water for the watering plants.

The catchment system uses to collect rainwater is using the rain gutter. The rain gutter usually installs on the side of the roof structure. This is because install at the side of the roof is the most suitable place to collect the rainwater. From the rain gutter the collected water will be flow to the rainwater storage at the greenhouse. To install the rain gutter there is a bracket to hold the rain gutter which is called gutter holder

Figure 1.1: Rain Gutter

(https://dailycivil.com/what-are-rain-gutters-types-of-rain-gutters/)

Figure 1.2: Gutter Holder

(https://www.shutterstock.com/image-photo/installing-black-plastic-rain-gutter-holder-1218114976)

There is various type of gutter holder in the current market such as hidden hangers, T-Bar or T-Strap Hanger and Exposed brackets and straps. This type of gutter holder is according to what type of rain gutter is use and the suitable situation the rain gutter been install. For the half round gutter is suitable use wrap-around hanger gutter holder. This is because to make sure it fit to the rain gutter design.

1.2 Problem Statement

There are various of current design gutter holder on the current market. The current design on the market is suitable to use on the flat surface. But to use on the pipe frame structure is not suitable because there is no flat surface on the pipe frame structure. Design layout of greenhouse is mostly using a pipe structure as their design. So, the structure of the greenhouse that use pipe frame is not suitable to use the gutter holder for the system catchment of rainwater.

Therefore, in this project the new design of gutter holder for pipe frame structure has been made. This new design be more focus to use on the pipe frame than the current design that use on the flat surface. Meanwhile, the current design on market mostly uses a material from pvc and mild steel. But for this project is use material that is anti-rusting which can use on the wet situation and long lasting.

1.3 Research Objective

In this objective are optimize the output of the project to be prove in results as follows:

a) To design a new gutter holder on pipe structure frame using a Solidwoks software

b) To fabricate a full-size working prototype of gutter holder

1.4 Scope of Research

The scope of this research are as follows:

- The gutter holder use at greenhouse pipe frame structure.
- Type of material used to fabricate is stainless steel.
- Dimension of gutter holder is specific to 5 inch rain gutter which standard rain gutter use at the greenhouse.
- Gutter Holder specific use at the g.i. 3-inch Pipe frame structure at Greenhouse.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to Gutter Holder

Gutter holder is a bracket that use to hold along the gutter drainage system. The most common hardware for securing the gutter to the roof fascia is this gutter holder. Gutter holder providing support, stability, and protection to the building structure. The rain gutter is not simply nailed to the roof; instead, it is supported by a gutter holder that is joined to the rain gutter. The rain gutter mostly uses on all building structure as their drainage system for the rainwater on the rooftop such as home residentials, industry and greenhouse. The greenhouse uses the rain gutter as one method to collect rainwater. In 2005, China discovered a method for collecting rainfall from the surface of greenhouses (*UA-Magazine*, n.d.). Without the gutter holder, drainage system for rainwater at the building structure may occurs some problems. As a result of this issue, substantial water damage will occur.

2.2 Greenhouse

The greenhouse is also called as the glasshouse. A greenhouse is a structure in which plants are cultivated under controlled conditions for various reasons (Olaifa et al., 2015). The greenhouse structure has been designed to keep different seasons plants against extreme cold or heat. Greenhouses as in 17th century were simple brick or timber structures with a reasonable amount of window area and some form of heating (Britannica, 2019). A contemporary greenhouse is often a glass- or plastic-enclosed framed structure used for the cultivation of fruits, vegetables, flowers, and other plants that require unique temperature conditions.

Usually, the greenhouse structure that build by the home gardeners was using pipe as pole to their frame structure building. The span-type greenhouse, that has a double-sloped, or A-shaped, roof, and the slender greenhouse, which seems to have only one roof slope and leaning against by the side of a structure, are the two primary structural shapes.

2.3 Type of Rain Gutter

The rain gutter has a various type and have their own benefits. Rain gutters are basic components of structure storm drainage system that support along the perimeter of the roof and collect rainwater runoff. A rain gutter is a part of a building's water drainage system (*REPORT - SMART RAIN GUTTER CLEANER*, n.d.). Rain gutters are often referred to as gutters or guttering. The downpipes, which assist discharge rainfall runoff as from rooftop to the drainage system, are connected or joined to these gutters. For the rain gutter there are many various of size according to the building where it's been installed. For rain gutter size there is 5-inch, 6 inch and 7 inch. For the standard size of rain gutter mostly use is 5-inch size.

2.3.1 K-Style Gutter

K-style gutters is one of the rains gutter types that have in the current market. This rain gutter be called as K-Style gutter because of the outside view of this gutter is look likely a K alphabet. To put it another way, the outside border is made up of a short, straight line from the gutter's bottom, two opposing curves, and another short straight line. Ogee gutters are another name for these gutters which is mean double curve. With the development of modern

mechanical production and seamless gutter technology in the 1960s, this gutter became widespread. This K-Style gutter has various of size such as 5-inch, 6 inch and 7 inch.

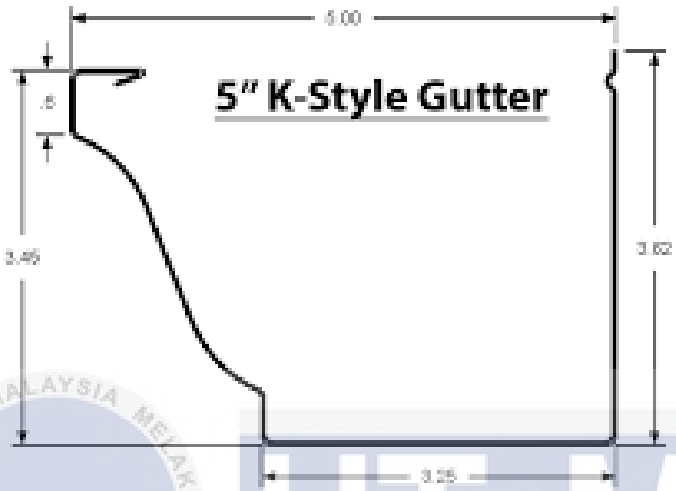

Figure 2.1: K-Style Gutter Dimension

(https://salemoregongutterservice.com/gutter-installation/)

The K-Style gutter is most common type of gutter to be use because there are many advantages. The advantage are;

- Because K-Style gutters are flat on one side, they may be nailed straight into the fascia board, which eliminates the need for several brackets to hold your gutters in place.

- Another benefit of K-Style gutters is that they will have a smooth finish, which means they are less likely to leak than other gutter kinds. You will be able to avoid water damage because of this.

- When compared to circular design gutters or other types of gutters, these gutters can store more water

2.3.2 Half Round Gutter

Half round gutter is like a tube that been cut in a half. Half-Round Gutters have a more conventional appearance and are best suited to homes/houses with a certain architectural style. The U-shape of these gutters is symmetrical. But for this half round gutter there is no flat side on their surface. Due to this problem, the installation of this rain gutter may be tough from the others type of rain gutter. To install half round gutter there will need a bracket or call as gutter holder that attached to fascia roof. Actually, fascia boards are typically out of level, but with standard gutters, the irregularity is hidden by the fall in the gutter(Hardie, 2010). Half round gutters are available in a variety of forms, including double-bead, single-bead, and reverse-bead.

The benefit of these half round gutter, its inside has a smoother surface than the K-Style gutter. When the surface inside is smoother it will affect creases for water to collect in. As of this result, this half round gutter is easy to keep clean than the K-Style gutter.