UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STRENGTH ANALYSIS OF 3/4'' JOINTER FOR JOINING 1/2'' PIPE IN GREENHOUSE

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Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical Engineering Technology (Maintenance Technology)
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DECLARATION

I declare that this Choose an item. entitled " Strength Analysis Of 3/4" Jointer For Joining 1/2" Pipe In Greenhouse" 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.

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Date : *18/1/2022*

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 (Maintenance Technology) with Honours.

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DEDICATION

Dedicated to my beloved mother , Kamiriah binti Abdullah and my father, Nor Zainudin bin Deraman. Thank you for always be by my side.

ABSTRACT

Greenhouse is one of the best and effective agriculture method for growing plants that requiring regulated climatic conditions. There are many types of greenhouse and one of them is galvanized steel frame greenhouse. In assembly process of the galvanized steel frame greenhouse, the 3/4" jointer strength is always in doubt when joining with 1/2" pipe. This research purpose is to determine the actual strength of the jointer and pipe after the installation of a galvanized steel frame greenhouse . The methodology used for this research is by conducting static analysis in the Solidworks 2021 software. The data is collected by conducting conducting static analysis in the Solidworks 2021 software using the 3/4" jointer and 1/2" pipe sample. The data is then analyzed and recorded . Based on the result, the discussion and conclusion is made. The results of this studies shows the actual strength of the 3/4" jointer when joining with 1/2" pipe in galvanized steel frame greenhouse when 4000 N of load is applied.

ABSTRAK

Rumah semaian merupakan satu kaedah efektif dan terbaik bagi penanaman pokok yang memerlukan keadaan iklim yang terkawal. Terdapat beberapa jenis rumah semaian dan salah satunya adalah rumah semaian yang diperbuat dari besi galvani. Dalam proses pemasangan rumah semaian ini, tahap kekuatan penyambungan di antara penyambung paip 3/4” dan paip 1/2" sering menjadi keraguan. Tujuan kajian ini dijalankan bagi menentukan tahap kekuatan sebenar penyambung paip dan paip setelah selesai pemasangan rumah semaian tersebut. Metodologi yang digunakan bagi kajian ini adalah dengan menjalankan analisis statik menggunakan perisisan Solidworks 2021. Untuk tujuan analisis, perisisan Solidworks digunakan untuk membuat lakaran dan simulasi ujian ketegangan terhadap penyambungan diantara penyambung paip dan paip besi bergalvani. . Data dikumpul dengan menjalankan analisis statik dalam perisian Solidworks 2021 menggunakan sampel 3/4" penyambung paip dan 1/2" paip besi bergalvani. Data tersebut kemudiannya dianalisis dan direkodkan. Berdasarkan keputusan tersebut, perbincangan dan kesimpulan dibuat. Hasil kajian ini menunjukkan kekuatan sebenar penyambung paip 3/4” apabila dicantum dengan paip 1/2” di dalam pembinaan rumah semaian jenis besi bergalvani apabila 4000 N beban dikenakan.

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LIST OF SYMBOLS AND ABBREVIATIONS

OD	-	Outer Diamter
ID	-	Internal Diameter
ND	-	Nominal Diameter
DWV	-	Drain, waste, vent
UTS	-	Ultimate Tensile Strength
ASTM	-	American Society for Testing Method

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CHAPTER 1

INTRODUCTION

1.1 Background

A greenhouse is a building structure with walls and roof constructed primarily of translucent material such as glass, in which plants that need to be controlled climatic conditions are grown. It is also called a glasshouse or hothouse. Flowers, herbs, vegetables, and fruits are often grown in greenhouses. The greenhouse is built to protect the plants from extreme temperature, humidity, and shielding from dust storms. Other than that, it also functioned to keep out the plants from pests and diseases. A greenhouse serves as a barrier between the plant areas and the external or the surrounding environment. The greenhouse is excellent for the whole planting process, from sowing seeds to harvesting the crop.

There is a wide range of greenhouses materials, equipment, and accessories that can choose to build a greenhouse. A greenhouse can be made out of almost any tubular material. There are many excellent choices for a high-quality greenhouse frame, including aluminium, galvanized steel, pipe, PVC, resin, and wood. There are, however, some essential materials that are needed. Low-maintenance, non-heat conducting wood, solid yet resilient galvanised steel, or thin, low-maintenance, yet robust aluminium alloys are all options for structural framing.

To have a greater span for the pipe framed greenhouse, an essential thing that needs to be considered is the pipe's strength and the connection joint. In engineering and construction, strength is referred to as the ability of a material to bear an applied load without

failure or plastic deformation. The material strength is also known as the relationship between external loads applied to a material and the consequent deformation or change in material dimensions. These characteristics must be considered when constructing greenhouses structures and connecting the pipe and jointer. The material chosen has sufficient strength to resist applied loads or forces while maintaining its original shape.

The jointer of the pipe structure is also one of the main factors that need to be considered before building a greenhouse. It is also known as connector or fittings. The jointer is used to connect two greenhouse pipes and usually operate on the greenhouse roof side. The jointer functioned as a supporting mechanism for the greenhouse frame and structure. It makes the structure more stable and stands strong against extreme weather. There is a various design of jointers such as 3-way jointer, 2-way jointer, and 5-way jointer. It also comes in different diameter according to the usage of the greenhouse. The jointer of the greenhouse pipe structure can undergo yield strength loss, looseness, and reliability issues from time to time. This will affect the lifespan of the greenhouse from time to time.

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1.2 Problem Statement

The pipe framed greenhouse is built with four main structures: the side posts, columns, cross ties, and purlins. The type of greenhouse construction is predominantly influenced by the structural material, though the covering material also influences the kind. To build a rigid greenhouse, the span of the structure will be determined by the structural components used and their construction. The greater the span, the stronger the material should be, and more structural elements should be utilised to create durable truss type frameworks. For shorter spans, simpler designs such as hoops may be used. Thus, greenhouses can be generically categorised according to their architecture as wooden

framed, pipe framed, or truss framed structures. It is frequently used in connection with jointers or fittings for pipe-framed constructions to ensure that the entire structure is solid and safe. When the pipe and jointer are joined, the strength of the pipe and jointer will be critical to the greenhouse's durability.Constructors of greenhouses often have great concerns about the installation of connectors and pipes. Due to the extreme load that the structure will carry after the installation is complete, the strength of the 3/4 inch jointer connected to this 1/2 pipe inch is in doubt. Strong forces, such as storms and environmental impacts, maybe too much for such connections to withstand. In the long run, this will indirectly affect the pipe connection, resulting in the greenhouse collapsing. As a result, several factors must be investigated, including the suitability of the material used to manufacture pipes and connectors, mechanical properties such as material strength, and physical properties of the pipes and jointer used.

1.3 Research Objective

This research aims to study the actual strength of a 3/4 inch galvanised steel jointer for joining the 1/2 inch galvanised steel pipe in a greenhouse assembly. Specifically, the objectives are as follows:

a) To design the 3/4 inch galvanised steel jointer and 1/2 inch pipe connection using Solidworks software.

b) To study and analyse the strength analysis of the 3/4 inch galvanised steel jointer and 1/2 inch galvanised steel pipe connection on the greenhouse strength by conducting static analysis using Solidworks Software.

1.4 Scope of Research

The scope of this research are as follows:

- The strength analysis of the material is based on the galvanised steel material for the jointer and pipe.
- The connection of galvanised steel pipe and jointer, built and analysed using Solidworks software.
- Conducting the static analysis with 4000N of load using Finite Element Analysis on the 3/4 inch jointer and the 1/2 inch pipe connection using Solidworks software.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will review the relevant literature and research on the greenhouse's structure, type of and mechanical properties. The definition of a greenhouse is discussed first, followed by the purpose and type of greenhouse. The theory on the material used to build the greenhouse is discussed in the second part. The third section focuses on the test that will be conducted for this research.

2.2 Greenhouse

A greenhouse is a method for controlling and adapting climatic conditions that enable plants to thrive in conditions that aren't ideal for their growth and development. The greenhouse technology becomes more important as the climate changes, emphasising high-quality produce and increased productivity via effective resource usage. Greenhouse productivity and efficiency are entirely dependent on the sorts of greenhouse structures utilised for production. The current trend in human population expansion and the advancement of consumption habits illustrate the need for creative greenhouse structures. In general, the kind and equipment of greenhouse structures used in any place are customised to the local environment, building materials, and crop. Growers, designers, and researchers in each region constantly evaluate components such as cover materials, climate-control systems, irrigation, and fertilising equipment in order to maximise efficiency, minimise inputs, and remove negative environmental effects. Due to the diversity of greenhouse

designs available for a particular area, it is essential to understand the advantages and disadvantages of each greenhouse type and building method (Dalai, 2020).

Figure 2.1 Galvanized Steel Pipe Frame Greenhouse

2.2.1 Purpose of Greenhouse

Concerns over global population increase and the impact of a decrease in the food supply are increasing. Although the global population has only grown numerically, this implies that the per capita food supply has decreased. This is more apparent in oils, vegetables, fruits, and milk, which have a lower oxidation rate. However, minor fermentation occurs in grain products. As a result of population growth, we've seen an increase in the amount of urban land used for residential purposes, a decrease in agricultural land, and thus an increase in food demand. It's a necessary follow-up that productivity and year-round cultivation are necessary to meet the resulting requirement. The sun provides all of the energy that plants and animals require. In other words, food is created when plants use photosynthesis to digest this excess energy (i.e. energy that is not used for bodily functions). This technique is performed in suitable air conditions. Certain of these conditions are maintained throughout the year by nature, while others are purposely generated in a greenhouse. The primary objective of a greenhouse is to produce agricultural products that

are not produced during the growing season. They create an ideal microclimate for plants, allowing them to thrive and fruit in locations where they would be unable to do so in open fields. A greenhouse is occasionally referred to as a "controlled environment greenhouse," which is precisely what it is. As we all know, growing plants in greenhouses are quite difficult; thus, the greenhouse's control aids the process by lengthening the period of plant growth. One of the advantages of summer greenhouse use is the excess of flowers and vegetables. In light of this, greenhouse technology has developed to create or maintain a favourable climate to grow a desired crop year-round successfully. The concept of "climate maintenance" can be applied to a variety of other processes, including crop drying, distillation, biogas plant heating, and air conditioning. It is a well-established fact that greenhouses are widely used. The area covered by greenhouses has increased dramatically over the last decade, with their total area now ranging between several hundred and a few thousand hectares (Omer, 2009).

2.2.2 Greenhouse Applications Around The World

Along with several nations where commercial crop cultivation is conducted undercover, there are over 50 nations worldwide where commercial crops are cultivated using a variety of methods. The United States of America has approximately 4000 hectares under greenhouses for horticulture cultivation, with annual revenue of more than 2.8 billion US dollars, and the area under greenhouses is expected to grow significantly in the future if transportation costs continue to rise (Pandey & Pandey, 2015). According to recent estimates, Spain has 25,000 hectares of greenhouses, and 18,500 hectares are used primarily for vegetable crop production, including watermelon, capsicum, strawberries, beans, cucumbers, and tomatoes. Tunnel greenhouses are primarily used in Spain, where they do not require extensive environmental control technology. Tunnel greenhouses were being

frequently used in Spain, and sophisticated environmental control technology is rarely used (Cantliffe & Vansickle, 2003).

The greenhouse sector in Canada is well-served by both the seasoned vegetable and off-season floral sectors. In Canada, greenhouses are primarily used to grow vegetables such as tomatoes, cucumbers, and hot peppers. According to hydroponic growers in Canada, customers prefer hydroponically grown vegetables, which can cost up to double the price of traditional greenhouse produce (Baudoin et al., 2013). Historically, the Netherlands has been the world's largest exporter of greenhouse-grown flowers and vegetables. Though only 89,600 hectares of greenhouses cover most of the Netherlands, the Dutch greenhouse sector is one of the most sophisticated in the world. Even though glass greenhouses are the most frequently used type of greenhouse in the Netherlands, which is constantly exposed to foggy conditions, the Dutch greenhouse industry continues to rely heavily on glass greenhouses to stay competitive. Extensive research and development initiatives have kept the Dutch greenhouse industry ahead of the competition (Pandey & Pandey, 2015).

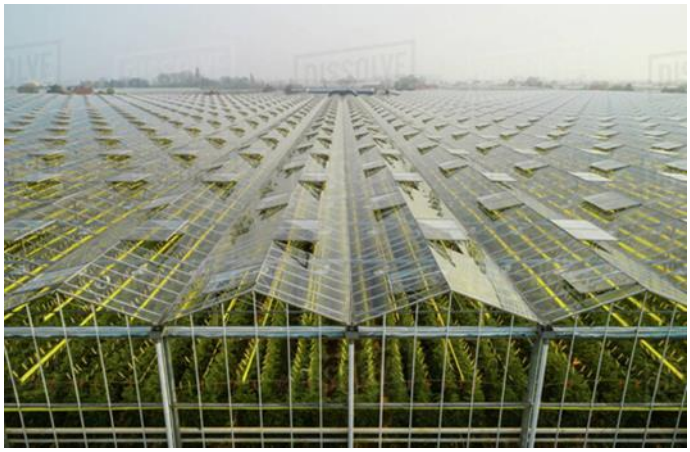

Figure 2.2 Modern Dutch Greenhouse