SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Structure and Materials)."

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Date : .....

REED GRASS AS SUSTAINABLE SOUND ABSORBER

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This report is submitted in fulfillment of the requirements for the award Bachelor of Mechanical Engineering (Structure and Materials)

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DECLARATION

"I hereby declare that the work in this thesis is my own except for summaries and quotations which have been duly acknowledged."

Signature : .....
Author : MUHAMMAD FAHMI BIN NOORDIN
Date : .....

DEDICATION

To my beloved parents.

Thank you for your care and support.

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ABSTRACT

The used of synthetic materials as acoustic absorbers are still practiced extensively in building industry. This is because the increasing of noise level affects people not only in the industry, but as well in the living environment. The high cost involved in the construction and renovation of noise barriers makes the growth of sustainable barriers necessary. Thus, researchers have now driven their attentions to find sustainable and eco-friendly materials to be an alternative sound absorbing. This paper discusses about the uses of reed grass to be a sustainable sound absorbing. The usage this fabric actually will also minimize the production cost since the reed grass is one of common natural waste materials that found across South East Asia. The sound absorption properties of reed grass have been investigated through experiment. Their acoustic properties were measured by using an impedance tube instrument. In summation, the characteristic impedance and the propagation constant of the fabrics were measured. The results shows that the reed grass has excellent acoustical performance to be sound absorbing fabric.

ABSTRAK

Penggunaan bahan-bahan sintetik sebagai bahan penyerap akustik masih dipraktikkan secara meluas dalam industri pembinaan. Ini adalah kerana peningkatan tahap paras bunyi yang memberi kesan kepada manusia bukan sahaja di dalam industri, tetapi juga dalam persekitaran hidup. Penggunaan kos yang tinggi yang dalam pembinaan dan pengubahsuaian penebat bunyi membuatkan pertumbuhan pemampan halangan perlu diwujudkan. Oleh itu, para penyelidik kini telah memberi perhatian untuk mencari bahan-bahan yang mampan dan mesra alam untuk dijadikan penyerap bunyi alternatif. Kertas kerja ini membincangkan tentang penggunaan rumput buluh untuk dijadikan penyerap bunyi. Penggunaan fabrik ini juga akan mengurangkan kos pengeluaran kerana rumput buluh merupakan salah satu daripada bahan-bahan buangan semula jadi yang biasa dijumpai di seluruh Asia Tenggara. Ciri-ciri penyerapan bunyi rumput buluh ini telah dikaji melalui eksperimen. Sifat akustik mereka diukur dengan menggunakan alat tiub galangan. Dalam eksperimen ini, sifat akustik mereka diukur dengan menggunakan alat tiub galangan. Dalam eksperimen ini, ciri-ciri galangan, pekali penyerapan dan tetap luang dari kain telah diukur. Keputusan menunjukkan bahawa rumput buluh mempunyai prestasi akustik yang sangat baik untuk menjadi bahan penyerap bunyi.

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°F	=	Fahrenheit
$\overline{\alpha}$	=	Absorption Coefficient
T_{60}	=	Reverberation Time
V	=	Volume
c	=	Speed of Wave
%	=	Percentage
f	=	Frequency of Sound Wave
λ	=	Wavelength

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CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

Until todays, the used of synthetic materials as acoustic absorbers are still practiced extensively in building industry. This is because the increasing of noise level affects people not only in the industry, but also in the living environment. A sustainable material is produced usually from natural or recycled materials and its production requires a small amount of energy. It makes special use of non-renewable resources and delivers a low environmental impact (Ersoy S. 2008). Therefore, researchers have now driven their attentions to find sustainable and eco-friendly materials to be an alternative sound absorbing. The need for new applications by addressing acoustic problems has been constantly growing.

Thus, the sound absorption properties of reed grass have been investigated. One of the reason is the reed grass are able to provide up to 80% absorption in a relatively broad frequency range (Asdrubali F. 2007). By increasing the layer thickness, this range can be expanded to the lower frequency regime. It has been found that the higher absorption properties of the tested samples are obtained sealing the reeds.

Generally, this research is about the potential use of reed grass as a sustainable noise absorber among the others natural materials by using the suitable testing method.

1.2 PROBLEM STATEMENT

In the final age, noise control was one of the major requirements to improve the living environment. For example, in the construction sector. The high cost involved in the building and renovation of noise barriers makes the growth of sustainable barriers necessary. One of the methods to execute that is provided by sound absorber. This survey was directed to look into the potency of using reed grass (*Imperata Cylindrica*) as sound absorbing. Different with the experiments before, this experiment using 3cm length of the reed grass that arranged in vertical arrangement.

1.3 OBJECTIVES

The objectives of this research are:

1. To design and fabricate reed grass as sustainable sound absorber.
2. To measure the sound absorption coefficient of the panel using the impedance tube.

1.4 RESEARCH SCOPES

The scope of project are:

1. Material preparation, design and fabrication.
2. Measurement of sound absorption coefficient in impedance tube.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will discuss the literature review in order to gain enough information that can be used to complete the research. It will includes the introduction of reed grass, usage of reed grass, overview of research in noise control in industry and also the analysis method used in previous research works. There are many advantages from the reed grass such as low density, cheap in cost, the availability, and biodegradable. Hence, the usage of reed grass has increased because of these advantages. The data's include in this chapter are taken from thesis, books, journals, and any academic articles that are related to the research topic and will be clearly cited.

2.2 REED GRASS (*Imperata Cylindrica*)

Reed grass or scientific name *Imperata Cylindrical*. Reed is tall woody perennial grass with hollow slender stems and sharp leaves. They can grow to a height of 1.5 meters. The leaves are green, long and straight with parallel veins and pointy at the final stage. The border of the leaves is rather piercing and cause injury if not careful when wielding it. The blooms are white, mild and smooth clump. Its stems called rhizomes typical scaly and sharp, and grow creeping on the earth. In Indonesia it is traditional medicinal plant used as treatment for lowering high blood pressure and pain relieving (Chee 2012).

Reed grass can find in the vicinity of Southeast Asia, Africa, India, Australia and tropical climes, such as North America, Central America and South America. In fact, the grasses are growing in some temperate areas, such as New Zealand and Japan. They thrive in countries that received rainfall in excess of 1,000 mm per year. Reed grass also lives in countries prone to flooding and fire resistant (Chee 2012). Consequently, the reed grass are easily spread into sandy areas, such as coastal, desert and watery habitats, such as swamps and river valleys. High growth rates have the reed grass quickly spread throughout the new country as a new pilot that threaten agriculture and plantation sectors.

The scientific name is selected from the remembrance services grass pharmacist Italy, namely *Ferrante Imperato* (1550-1631). He is actively involved in the field of natural resources and the author Dell'Historia Naturale. Another name for them is the weeds in Indonesia, kunai in Papua New Guinea, co tranh (Vietnam), Eye and gogon (Philippines), yet-mei (Myanmar) and O - kha (Thailand). They are also known as congress and satin tail in English **(**Chee 2012**).**

Figure 2.1: Reed Grass (*Imperata Cylindrica*)
(Source: Troya M. T. 2009)

2.3 SOUND

Sound is the sensation of hearing. It is any pressure variation (in air, water, or other medium) that the human ear can detect. Sound is developed when a source defines the air closest to it in motion. For instance, when a tuning fork is taken, it vibrates, causing the air around it to move back and forth creating a variation in normal atmospheric pressure. Then it will create alternate layers of expansion and contraction to move off from the vibrating source. These compression waves can we say as sound. The pressure fluctuation (amplitude) determines the loudness and the number of fluctuations its frequency.

Sound waves move around in the air at a speed which is temperature dependent. The velocity of sound is about 1130 feet per second at 70°F. The frequency of sound is measured in cycles per second, and is called Hertz (Hz). The human hearing range is about 20 to 20,000 Hz (Mueller 2001).

The wavelength of a frequency is announced by the Greek symbol λ and is calculated by splitting up the focal ratio of sound by the frequency. For comparison, the wavelength of 20 Hz at 70°F is 56.5 Ft. and 20,000 Hz at 70°F is approximately 11/16 In. long (Mueller 2001). Hence we see that high frequencies have short wavelengths and low frequencies have long wavelengths.

2.4 NOISE CONTROL

Noise is can be defined as any unwanted sound. Noise may be continuous or erratic depending upon the source. It annoys, distracts and generally upsets the environment. Noise affects people in a bit of ways. If sufficiently intense, noise may damage hearing or health, interfere with work tasks, interfere with speech communication, interrupt sleep, or cause irritation.

Noise can be controlled by addressing their origin, track or recipient. Noise control at the source. A noise source is created by the motility of a solid, liquid, or gas. A solid source may be quoted if its manner of performance is shifted so that it moves less. Liquid and gaseous sources may be piped down by reducing flow velocity, smoothing flow, and attenuating pressure pulsations (Zulkifli R. 2010).

Control at the source by planning while the merchandise is in the design stage is often the most cost effective and least expensive control measure. Most corrective measures for an existing noise control problem utilizes changes in the path. Solutions for path noise control include barriers, enclosures, silencers, and dampers, vibration dampening, and vibration isolation.

Thus, we can state that noise control can result in improved worker communication, increased productivity, higher tone of work output and a quieter, safer environment. This involves the use and application of sound absorption materials, acoustic shields and barriers, acoustic enclosures and silencers.

2.5 IMPEDANCE TUBE (using Two-Microphone Method)

The methods to use an impedance tube with two microphones is to obtain the acoustic features of materials samples. This setup can also be utilized to assess the absorption coefficient in-situ on road surfaces, as a non-destructive alternative to fit drilled out road samples into the tube. Besides that, impedance tubes can also be applied to receive the non-acoustic parameters of a porous material using multiple microphones and transfer function computations.

This setup also can be used to measure the absorption coefficient in-situ on road surfaces, as a non-destructive alternative to fit drilled out road samples into the tube (Andrew 1989). Moreover, impedance tubes can also be used to obtain the non-acoustic parameters of a porous material using multiple microphones and transfer function calculations.

The two-microphone method is shown schematically in Figure 2.2 below. A sample of the material to be tested is placed in a sample holder and mounted to one end of a straight tube. A rigid plunger with an adjustable depth is placed behind the sample to provide a reflecting surface. A sound source, typically a high-output acoustic driver, is connected at the opposite end of the tube. A pair of microphones is mounted flush with the inner wall of the tube near the sample end of the tube.

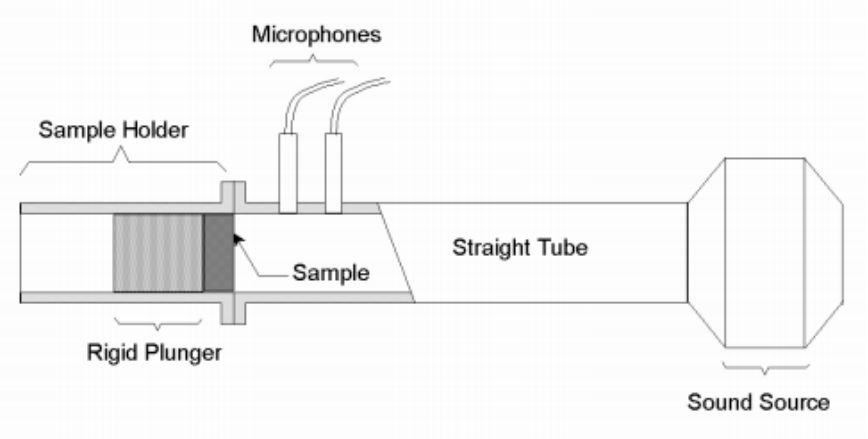

Figure 2.2: Two-Microphone Method
(Source: Andrew 1989)