RELATIONSHIP BETWEEN WOOD TEXTURE AND WOOD SURFACE ROUGHNESS: AN EMPIRICAL STUDY

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RELATIONSHIP BETWEEN WOOD TEXTURE AND WOOD SURFACE ROUGHNESS: AN EMPIRICAL STUDY

By

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A Project Report Submitted in Partial Fulfilment of the Requirements for the Degree of Bachelor of Wood Science and Technology in the Faculty of Forestry
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DEDICATION

Dedicated to:

My beloved family

To all my batch mates

To all my course mates

As well as

To all my friends who give me full support

To complete my Final Year Project

ABSTRACT

The wood surface roughness has become more important in wood industry in recent year due to the effect of profitability and production speed. Thus, this study was conducted with the key purpose to investigate the relationship of wood texture (pores size and pores distribution) and wood surface roughness of 3 common used timber species from different density group which is Balau, Dark Red Meranti and Rubberwood. This study also keens to find out the effect of wood texture on wood surface roughness before and after sanding. 30 samples defect-free were obtained and processed with sanding using 180 grit sandpaper. Roughness and anatomical structure were analysed using international method. The findings of correlation showed that both indicators of wood texture have positive relationship with the indicators of wood surface roughness, which are Arithmetic mean deviation of the profile, Ra and average maximum peak to valley of profile, Rz. In multiple linear regression, four models were built and all models showed impact of wood texture to the indicators of wood surface roughness. The results concluded that wood texture has minimum influence on wood surface roughness even it is before and after sanding.

ABSTRAK

Kekasaran permukaan kayu telah menjadi penting dalam industri kayu pada tahun baru-baru ini disebabkan oleh kesan yang dibawa kepada keuntungan dan kelajuan pengeluaran. Oleh itu, kajian ini dijalankan dengan tujuan utama untuk menyiasat hubungan antara tekstur kayu (saiz liang dan taburan liang) dan kekasaran permukaan kayu dari 3 spesies kayu yang biasa digunakan mengikut kumpulan kepadatan yang berbeza iaitu Balau, Meranti Merah Merah dan Rubberwood. Kajian ini juga mengujakan untuk mengetahui kesan tekstur kayu pada kekasaran permukaan kayu sebelum dan selepas pengamplasan. 30 sampel bebas dari kecacatan diperoleh dan diproses dengan pengamplasan menggunakan 180 grit sandpaper. Struktur kasar dan anatomi dianalisis menggunakan kaedah antarabangsa. Penemuan korelasi menunjukkan bahawa kedua-dua petunjuk tekstur kayu mempunyai hubungan positif dengan penunjuk kekasaran permukaan kayu, iaitu Aritmetik min sifar profil, Ra dan puncak maksimum purata ke profil lembah, Rz. Dalam pelbagai regresi linear, empat model telah dibina dan semua model menunjukkan kesan tekstur kayu kepada petunjuk kekasaran permukaan kayu. Hasilnya menyimpulkan bahawa tekstur kayu mempunyai pengaruh minimum terhadap kekasaran permukaan kayu walaupun sebelum dan selepas pengamplasan.

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APPROVAL SHEET

I certify that this research project report entitled “Relationship Between Wood Texture and Wood Surface Roughness: An Empirical Study” by Tan Zheng Shing has been examined and approved as a partial fulfilment of the requirement for the degree of Bachelor of Wood Science and Technology in the Faculty of Forestry, Universiti Putra Malaysia.

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INTRODUCTION

1.1 General Background

Wood has been used as a material since ancient time. In the old days, they used wood to manufacture a lot of tools which were used in daily life. That was the start of the woodworking industry. Woodworking has improved from time to time. In the seventeenth century, Robert Hooke discovered the vessel and pores of different size in charcoal under the microscope (Baas, 1982). Since then, wood anatomy was introduced to the world and the efforts were continued and developed by the others to improve the woodworking industry.

There are a few of wood anatomical features such as vessels, rays and parenchyma, which are always investigated by researchers. The anatomical features of wood have some effects on the properties of wood (Dadswell, 1957; Burley and Palmer, 1979). The properties of wood that get influenced are the physical and chemical properties. In physical properties such as wood texture is related to the anatomical characteristics according to the study of Toong et al. (2014). Wood texture is mainly affected by the relative size of wood cells (vessels, rays and parenchyma). “Fine-textured woods have uniform structure with typically small cells whereas coarse-textured woods generally have structure with concentrations of large diameter cells” (Alex, 2010). The differences of wood texture will affect the sanding quality and wood surface roughness.

In the case of sanding, wood texture will influence the wood surface quality after the wood sanding process as the course texture of wood are more readily to function as masking function to hide the scratch mark which is formed by using the abrasive tools (Ratnasingam et al., 2004). However, this knowledge is yet to be applied by the woodworking industry. The woodworking industry only apply sanding as a process that help to remove the uneven surface of the wood by using the abrasive tools to prepare the wood surface for coating or other processes. To prepare a smooth surface of wood, there are two stages of sanding process. First stage is levelling of uneven wood surface and eliminating the surface defects, which are produced in the previous machining processes. Second stage is smoothing of wood surface to produce finer scratch. In order to achieve smooth surface of wood, different grits of sandpapers are chosen according to quality of surface roughness desired. For first stage, a lower grit sandpaper is chosen. In smoothing stage, a higher grit sandpaper is chosen and keep replacing with a higher grit sandpaper progressively until the desired smooth surface of wood is achieved. However, wood sanding does not have any specific standard in common. Hence, the woodworking industry is still practicing the trial and error method in order to produce the best surface quality as the wood surface roughness is always the priority standard for consumers to purchase the wood-based products.

When it comes to the measurement of wood surface roughness, there is no specific standard to act as reference. Therefore, touching and rubbing always become the only method to determine the wood surface roughness. But the wood surface roughness can be affected by the anatomical characteristics and sanding processes, which cause the determination method become unreliable (Funck et al. 1992, Krisch and Csiha 1999). Still there is a method to measure the wood surface roughness in the study of Wood Science which is profilometer. It is much more reliable compared to the conventional determination method. There are four types of techniques to measure the wood surface roughness which is optical, stylus, pneumatic and acoustic emission. Each of them has own advantages and disadvantages (Ratnasingam et al., 2004). Hence, the best method to measure the wood surface roughness does not exist. Other than that, wood is hygroscopic and anisotropic. This indirectly increase the difficulty to measure the wood surface roughness. Therefore, wood surface roughness measurements must be carried out over lengths in order to provide an accurate and reliable assessment. Besides, the choice of technique has to be taken into consideration also according to characteristic of the wood.

1.2 Problem statement

It is a fact that Malaysia has been one of the main exporter of timber and timber products such as furniture and plywood. According to the statistic from Malaysian Timber Industry Board, furniture and plywood contributed a total 54.6% of total export of timber& timber products as shown in Figure 1.

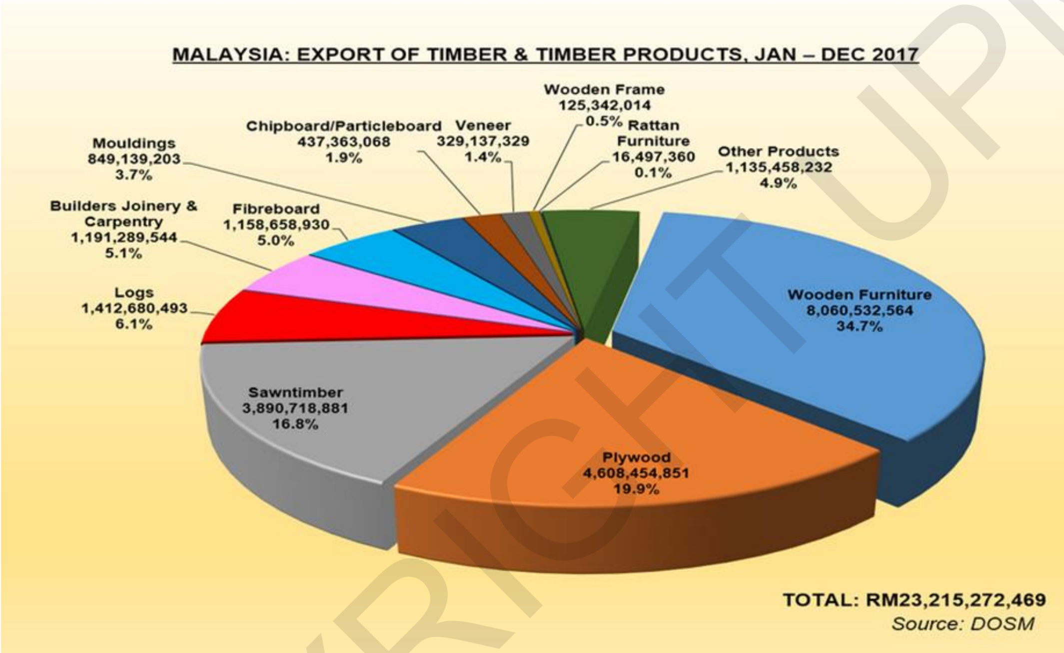

Figure 1: Statistic of Export of Timber and Timber Products in Malaysia at 2017.

The exportation of products have to be in the best quality thus the value-added process, sanding has to be done so that it will not affect the price of products. Besides, the less efficient sanding will increase the production cost and indirectly decrease the profit. However, from the previous sections, it is stated that the sanding practice is still on a trial and error basis. The negative impact will have an effect on the price of the secondary wood-based products due to the trial and error basis is significant. With this method, the sanding process is not in the optimum way and it will cause the open-end grain or close-end grain that will affect the application of wood furnishing. Besides, the operation cost will increase because the short period of abrasive wear-out, downtime of production due to changing of abrasive, wastage on the wood due to unsuitable sanding, and labour cost. The effect at the end will lead to economical lost. In order to solve this problem, the relationship between the wood texture and wood surface roughness has to be established. The findings will help in choosing sandpaper grit so that the optimum sanding can be done in high efficiency.

In previous study, the relationship between wood texture and wood surface roughness has proven that even the species and its density are different (Thoma, Peri and Lato, 2015). However, the finding was based on the softwood species like Abies alba and Pinus halepensis; hardwood like Fagus sylvatica and Quercus petraea. The hardwood species that exist in the tropical country like Malaysia have not been studied and the relationship between wood texture and wood surface roughness is significant. Hence the study tries to fill the gap filled so that the relation can be useful and beneficial for other research purpose someday.

To fill the study gap, the hardwood species chosen is the commonly used species in Malaysia which are Balau (Shorea laevis), Red Meranti (Shorea spp.) and Rubberwood (Heavea brasiliensis) to replace the species that is used in this preliminary study.

1.3 Objectives

1. To determine relationship between wood texture and wood surface roughness of three common Malaysian hardwoods, Balau (Shorea laevis), Red Meranti (Shorea spp.) and Rubberwood (Heavea brasiliensis)

2. To determine the effect of wood texture on wood surface roughness before and after sanding.

1.4 Scope of Study

In the scope of study, the parameter, arithmetic mean deviation of the profile, Ra is chosen. The wood species that chosen is common used species in Malaysian according to density. For Balau (Shorea laevis) is heavy hardwood which is high density range from 800kg/m^3 to 1120 kg/m^3, Red Meranti (Shorea spp.) is medium hardwood which is medium density range from 720kg/m^3 to 880 kg/m^3 and Rubberwood (Heavea brasiliensis) which is light hardwood range from 400kg/m^3 to 720kg/m^3.

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