



DESIGN AND ANALYSIS OF A DOUBLE GUIDED ROLLER FOR A JIGSAW

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ABSTRACT

Jigsaw machines are common cutting tools and used in a large scale in wood working industries. The main problem with jigsaw usage is imprecision cutting due to blade deflection and human handling method. In this paper, a new design of second guided roller for the jigsaw to avoid blade deflection is introduced. A steel arm which holding the second guided roller and a platform with a guided fence are also presented. The cutting finding with and without using this tool is compared and reported. It is found that the jigsaw paired with this tool is able to cut a better straight line with a smooth cutting surface.

Keywords: blade deflection, precision cut, jigsaw, double guided roller.

1. INTRODUCTION

A jigsaw is a handy and low cost cutting machine used by most carpenters worldwide. A jigsaw can do variety of tasks and could cut everything from wood to cardboard and from aluminum to alloys by changing a proper blade suit to its task. Usually, it is used for a small cutting project such as to cut a thin layer of a wooden plank. The cutting operation is done manually by moving the jigsaw on wooden plank in any desired direction. For this purpose, a very skilled labor is required for cutting preferred profile especially for a long straight line. Even though a skillful operator is used, it is very difficult to get a precise straight cutting line. Another disadvantage of using the jigsaw is that the blade deflects when cutting a hard or thick wooden plank. As a result, an uneven surface of the edge of the cutting wooden plank is obtained. Hence the aim of this project is to reduce the uneven cutting edge problem by introducing a second guided roller for the jigsaw blade. The report also includes the setup of the jig saw table with adjustable fence in order to get a straight line cut.

Actually there are many types of cutting machine that can perform a long straight line cut with precise and even edge such as table saw and circular saw. However this kind of cutting machine will cost more as compared to jigsaw. Even though circular saw is not too expensive relative to jigsaw, it has its own drawback. Circular saw cannot perform curvy cut. Therefore a jigsaw is still relevant and to avoid uneven edge cutting, the new technique is introduced and described in this report.

2. METHODOLOGY

In this paper, a comparison of between before and after using this new method is reported. This is a common method and has been previously reported for other types of cutting machine [1-2]. The cutting speed of the jigsaw is set at the same rate by setting up the control lever as shown in Figure-1.

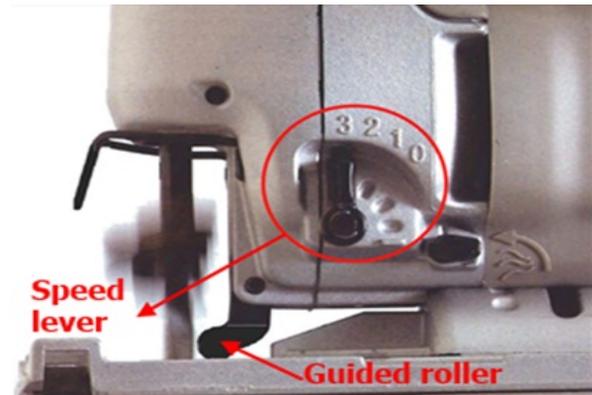


Figure-1. Speed lever and guided roller on a jigsaw.

This is important because the cutting efficiency of a jigsaw machine depends on cutting speed and feeding ratio [3]. However, the feeding ratio is assumed to be at the same rate because a human operator controls the machine. The type of jigsaw blade is also retained in this comparison because a different blade can produce different cutting quality [4]. Another main factor which can contribute to the finishing quality is the hardness of the wood used [5]. In this report the same type of wood is used for cutting purpose. In order to analyze the finishing quality easier, the cutting direction with respect to the wood line must be retained. According to J. Kovac et al [6], there are many other parameters that affect cutting power such as cutting angle, blade width, number of blade tooth, etc. All these parameters will affect the feeding ratio and yield a different finishing quality. As mentioned earlier, the feeding ratio is assumed to be at the same rate because human operates the jigsaw.

3. SETUP

The development of the cutting machine consists of two main sections. The first section is a second guided roller for the cutting blade attached to a steel arm as shown in Figure-2. The guided roller can be placed at any



location along the steel arm by loosening a single bolt nut. The second section is called the main platform which consists of an adjustable fence. There is a rectangle hole in the middle of the platform where the jig saw is attached upside down to the flat platform.

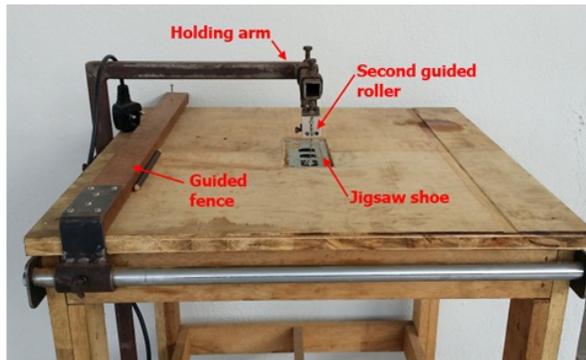


Figure-2. Laboratory setup.

3.1. Second guided roller

In recent years, most of the jig saw is equipped with guided roller to avoid blade deflection during cutting process. However, the guided roller only covers one end of the jigsaw blade as shown in Figure-1. This is not enough especially when dealing with hard wood or any hard material such as copper or steel pipeline. Therefore, the second guided roller is introduced. In this setup, two types of guided roller for the blades is described and reported. In the initial setup, the cutting machine used a fixed alley guided roller. It can only be used for a certain jig saw blade width and changing to a different size is not possible. The roller is made from a 10 mm diameter steel rod and cut for a 8 mm long as illustrated in Figure-3. Then an alley of 2 mm width is created using a lathe machine to allow the jigsaw blade to move up and down.

Then a small hole is drilled in the middle of the roller wheel. A 3 mm diameter steel rod was inserted in the hole as a shaft so that the roller wheel can spin freely. The shaft is then attached to a 'L' shape hook using a welding machine. This hook can move freely along the holding arm and can be tightened using a single bolt.

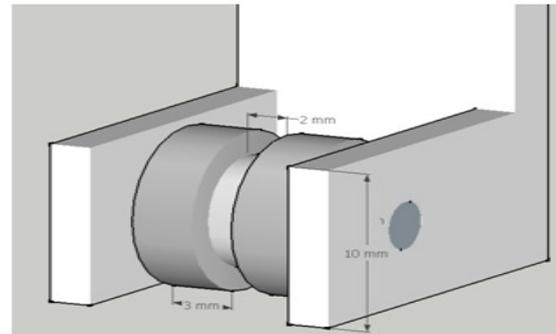
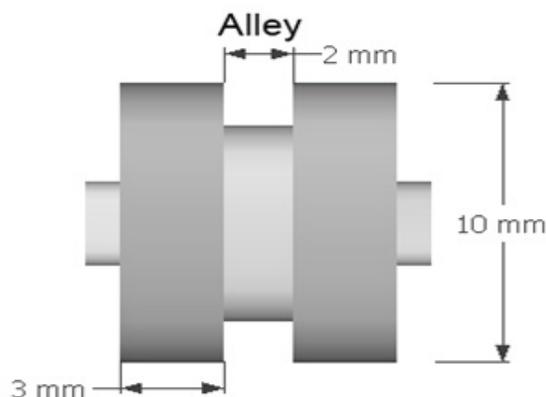


Figure-3. Schematic diagram of a roller.

In further setup, the alley of the guided roller can be adjusted to the size of jig saw blade width. The main component of the second guided roller is made from a light alloy cube as shown in Figure-4.

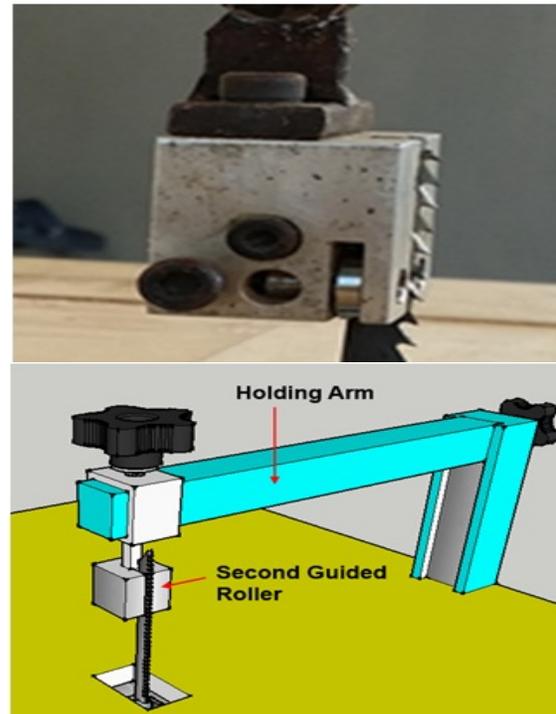


Figure-4. Second guided roller attached to holding arm.

The jig saw blade moves freely up and down through the alley of the alloy cube but it is guided vertically by two rollers. The cube size is approximately 5x5x6 cm and is attached to a T-shape steel and attached to a holding arm by a single bolt. It can move along the holding arm so that the second guided roller can be placed exactly at the back of the jig saw blade. This is to ensure that the tip of the jig saw blade has a good support especially when cutting a hard material. This is another benefit of having the second guided roller. It is not only can guide the jig saw blade vertically, but can also prevent the blade from broken.



3.2. Main platform

The second section of the cutting machine is called the main platform. It consists of a flat surface 60 x 60 cm square plywood and attached to a self-made wood table. On top of the table, a straight rectangle piece of wood is placed as a guided fence when cutting is done. This wood fence moves freely across the platform and it is attached to the table using a self-made hinge. The hinge easily moves along a steel rod, which is placed at one edge of the table. In the middle of the wooden platform, a rectangle hole (145 x 65) mm is made so that the jig saw blade could come out of the platform surface. In this setup the rectangle hole is cut so that it matches the jig saw shoe size. Four screws are used to attach the jig saw to the platform and are properly tighten up so that it would not vibrate and affect the cutting quality.

4. RESULTS AND ANALYSIS

In this testing, a single type of solid wood is used to check the quality of cutting. Shorea wood also known as 'Meranti' by local people is considered a hard wood with a density of 415-885 kg/m³ air dry [7]. This wood is used for cutting test because it is easily available and has a good strength property [8]. A seven feet long with 17 mm thick Meranti wood piece is cut parallel to the wood line using a jigsaw manually controlled by a semi-skilled carpenter. The machine is set at the same speed. The feeding is retained at the same rate, which is approximately 0.28 m/min. This was then compared using a jigsaw with a double guided roller as proposed. It can be seen that cutting using a jigsaw with a second guided roller produces much better quality cut. It produces straight line cutting with smooth and even cutting surface. To make the cutting effect clearer, the cut wooden stick was placed on a flat surface table as shown in Figure-5. Figure-5 (a) shows that the wooden stick is unable to lay down on the flat table properly due to uneven cutting surface. It shows that the blade does deflect during the cutting process. On the other hand, when double guided roller is used, the cutting surface is more even and smoother that reduces the gap between them as shown in Figure-5 (b). The wooden guided fence helps in improving the straight line cutting and produce better quality cutting surface.



Figure-5. (a) Cutting effect without double guided roller and (b) with double guided roller.

In another experiment, only a guided fence is used without the double guided roller. The result shows that the jigsaw can cut in a straight line. Nevertheless, the cutting surface shows a few sets of wrinkles as shown in Figure-6. It proves that the jigsaw blade was deflecting during the cutting process. These wrinkles can be eliminated if the second guided roller was used and a better smooth cutting surface can be obtained.

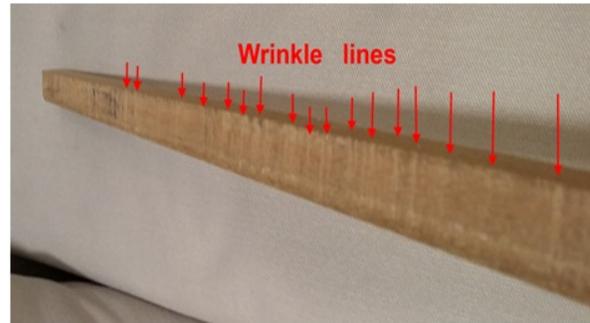


Figure-6. Wrinkle lines on cutting surface.

5. CONCLUSION AND FUTURE WORK

A new technique to avoid cutting problems using jigsaw especially blade deflection has been described. The usage of the second guided roller for the jigsaw shows very good cutting result. The quality in term of straight line cutting of the wooden piece is enhanced further by adding the guided fence on the platform. The second guided roller also increases overall performance of the jigsaw and can extend the blade life span. Based on this promising result, it has a big potential that this new tool can be commercialized in the near future. Therefore, prototyping this kit and reliability testing are our next steps to produce a reliable cutting tool.

ACKNOWLEDGEMENT

The author would like to thank the staff of the Faculty of Engineering Technology, University of Malaysia, Pahang (UMP) for their assistance and support during the development of the double guided roller kit. The author would also like to acknowledge the financial support made available through FTek for this innovation technique.

REFERENCES

- [1] Costes J. F., Ko P. L., Ji T., Petit C and Altintas Y. 2004. "Orthogonal Cutting Mechanics Of Maple: Modeling A Solid Wood-Cutting Process", ISSN: 1435-0211 DOI: 10.1007/s10086-003-0527-9 Issue: Volume 50, Number Springer-Verlag Tokyo pp 28-34.
- [2] A. Ozkan, S. Ayan. 2012. "New driver unit design and application for circular saw machine" Journal of Engineering Research and Applied Science, Volume 1(1), pp. 26-33.



- [3] Joseph P. Domblesky, Thomas P. James, G. E. Otto Widera. 2008. "A Cutting Rate Model for Reciprocating Sawing" ASME Journal. Manufacturing. Science. Engineering. Vol. 130(5), 051015.
- [4] Salih Aslan, Hakan Coşkun, Murat Kılıç. 2008. "The effect of the cutting direction, number of blades and grain size of the abrasives on surface roughness of Taurus cedar (*Cedrus Libani* A. Rich.) woods", Building and Environment, Volume 43, Issue 5, pp. 696-701.
- [5] H. Aknouche, A. Outahyon, C. Nouveau, R. Marchal, A. Zerizer, J.C. Butaud. 2009. "Tool wear effect on cutting forces: In routing process of Aleppo pine wood", Journal of Materials Processing Technology, Volume 209, Issue 6, 19, pp. 2918-2922.
- [6] J. Kováč, M. Mikleš. 2010. "Research on individual parameters for cutting power of woodcutting process by circular saws" Journal Of Forest Science, 56(6): 271-277.
- [7] Engku Abdul Rahman Chik. 1988. "Basic And Grade Stresses For Some Malaysian Timbers". Malayan Forest Service Trade Leaflet No. 38. The Malaysian Timber Industry Board And Forest Research Institute Malaysia, Kuala Lumpur. p. 13.
- [8] Menon, P. K. B. 1986. "Uses of Some Malaysian Timbers". Revised by Lim, S. C. Timber Trade Leaflet No. 31. The Malaysian Timber Industry Board and Forest Research Institute Malaysia, Kuala Lumpur. p. 48.