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Recent Publications

Published
1. MZ Rizlan et al., The Int. J. Adv. Manuf. Technology, 114, pp. 1871-1892, 2021.

Active Grants

RU Grant
Title: Formability Analysis of Tailor Welded Blank of Steel and Aluminum Alloys, 2019-2021

PRGS Grant
Title: Prototyping of hybrid machine; 2019-2022

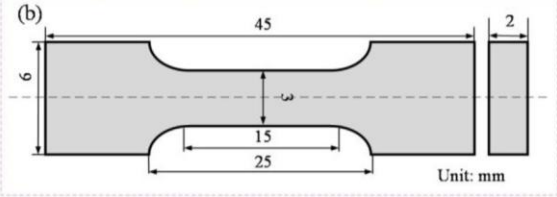
Preface

In this quarterly issue, the editor would like to highlight on a few issues related to the preparation of the 3D welded specimen made of conventional MIG welding machine.

One of limitations of welding-based metal additive manufacturing is final look of the bead, which is consider as near net shape and requires additional process like machining to get the final shape with good dimensional accuracy. Since the produced bead is relatively small and thin, it requires special setup and facilities for the task. Based on dogbone specimen for tensile test as shown in Figure below, at least two machines are required, surface grinding and wire cut machine. Surface grinding will be used to get the final thickness and EDM wire cut is to get the profile. However, still special tool/jig must be used to associate these two processes. For surface grinding, addition to magnetic chuck/table, a stopper at all sides is also required to avoid flying specimen during the machining.

Similarly, for the EDM wire cut as the specimen geometry is not even and surface is quite rough. Additional tool is needed to hold the specimen during the cutting. All above steps may affect time and cost for the task given.

Therefore, an alternative is critically needed for the task to be simplified and a new machine or at least, a special tool or rig need to be developed. The article in this quarterly issue, will focus on the design and review of the available machine in the market. Based on the proposed design, a new machine/rig will be modelled and developed for sustainability of the research.



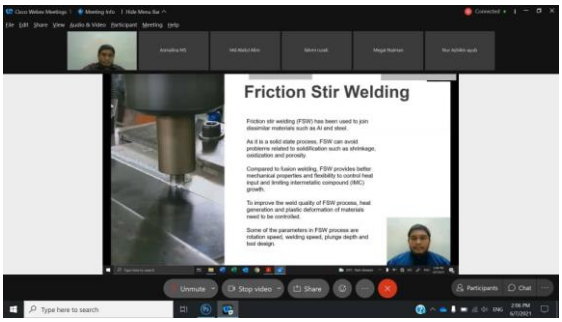
Highlight

E-book is now becoming new reading approach as the use of mobile devices like phone, tablet, and laptop are now the trends. 8 out of 10 peoples have their own device. In addition, during the pandemic, the requirement for those devices become more and more importance. Schools are implementing PdPR, universities are moved to online method in all their teaching and learning deliveries. Even groceries, food and consumer products are now online and no more needed to go to the shop or supermarkets as the SOP is now become more and more stringent.

E book industries are now growing like *cendawan selepas hujan*. There are numbers of established platform like google, amazon and many more, who are already make millions of sales annually. Malaysia also facing the trend. There are new and already stabilized platform at organization or individual, like https://indiework.usm.my/, manage by CDAE of USM and http://www.drnorzilaebookstore.com, by one of the USM Health's Campus lecturer.

Metal Forming Research Lab is also moving towards that initiative. Begins with the creation of this Bulletin since 2017 and now already at the end of year 5. Last month, another achievement as an e-book published on the indie@USM platform. The book is Pembelajaran Berasakan Pengalaman – Perkongsian Pengalaman.

Participation in IMEET 2021 – Virtual Conference



Mr Muhammad Zulkhairi Rizlan (PhD student) has presented part of his work at International Conference on Mechanical, Electric/Electronic Engineering and Technology (IMEET 2021) organized by the School of Mechanical Engineering, USM on 6th of July 2021. His paper entitle "Microstructure observation and hardness study of friction stir welded blank of Aluminum to steel". The conference held virtually due to MCO. The joint conference with RAISER 2021 was participated by more then 100 participants from various countries like Indonesia, Thailand and many more.

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MINI SURFACE GRINDING MACHINE – A SHORT REVIEW ON DESIGN, CONFIGURATION AND MECHANISM

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Abstract
Preparation of small and thin specimen is a challenging task. Specimen with non-uniform thickness and uneven height and width, make the process more challenging. Typically, machining likes milling is used to get the desired plate thickness, however for specimen less than 10 mm, this method is anymore practical. As an alternative, surface grinding can replace the milling process. Unfortunately, the cost for the machine quite high and not worth to buy for the application. There are many mini surface grinding machines with a table-top size available in the market. In this article, the design concept, configuration, and mechanism involve will be reviewed and recommend for fabrication. (Note that this is a project for internship student)

Introduction
Machine tools and cutting tools have made significant advances in recent years. Machining was a difficult task to perform a few years ago, but it has now become commonplace and has been simplified by more advanced technology that has been involved. Machining is a broad term that refers to the removal of material from a work piece. Grinding is a finishing process that removes a small amount of material to improve surface finish, abrade hard materials, and tighten tolerance on flat and cylindrical surfaces. Grinding is a necessary step in the final machining of components that require smooth surfaces and precise tolerances. Due to the large number of variables involved, the grinding process is regarded as one of the most complex tooling processes. However, such a process should be used in finishing operations where good final quality and low roundness errors of the piecework are expected, and where the reduction of the diametrical wear of the grinding wheel should always be sought to reduce the costs of the process.

As shown in Figure 1[1-2], a typical grinding machine consist of 4 main modules, 1) grinding module, 2) worktable (x-y axes movement), 3) main body and 4) wheel head column (z axis movement). List below further elaborate the component of the machine.

Module 1 – grinding module	Module 2 - fixture	Module 3 – machine tool	Module 4 – Wheel head column
Grinding wheel	Table	Base	Motor attachment
Wheel guard	x-y axis linear guide (handwheel)	Saddle	Raising mechanism
	Magnetic chuck	Accessories like control panel, handwheel, coolant tank, dust extractor, toolbox etc.	

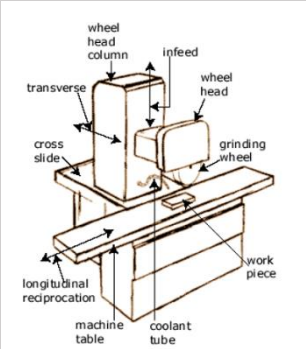

Figure 1

Instead of main parts as listed, there are many accessories that comprise the control panel, handwheel, coolant tank, dust extractor, toolbox etc. It is important to select the suitable and appropriate part. In the machine design process, selection of part to be custom-made and to purchase also important. For example, motor to rotate the grinding wheel, is better to buy on the shelf and not worth to fabricate. Similarly, grinding wheel, worktable, and magnetic chuck. While other parts, such as base, wheel guard, main body of the machine can be fabricated in-house.

There is an option of fixing the wheel head column and movement of the worktable is at 3 axes i.e., x, y and z. This makes the design simpler, as the grinding wheel can be directly attached to the motor, and the issue on raising mechanism can be neglected. Multi-axes table, either more than 2 axes (x-y-z or x-y-z-R) or just 2 axes (x-y) table as shown in Figure 2 are available online (Lazada, Shopee etc). However, the maximum size available of 90x90 and 300x90 mm, with maximum travel of 12.5 and 10 mm (x-y and z) and 200 and 50 mm (x and y) respectively. These are the limitation of the parts.

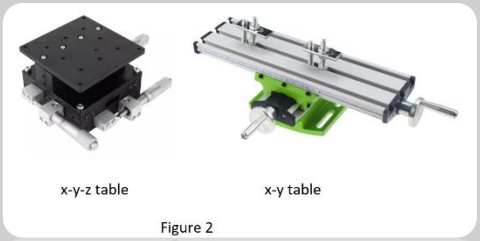

Figure 2

Selection of magnetic chuck is also important. There are various geometry (sizes and shape), compatibility and holding force to be selected. Based on the specimen geometries, rectangular chuck is suitable and additional stoppers are required for thin plate to avoid wobbly specimen fall onto operator, which may cause injury.

Design of the base is very important as it's affected stability of the machine[3]. The base must be rigid and provide a space to locate all accessories like control panel, handwheels, coolant etc. To simplify the design, a 25 mm thick mild steel plate is going to be used as the base material and assemble using fastener.

The next step is the development of the conceptual design by sketching of the machine parts, begins with the base, wheel head column, the grinding wheel guard and all parts to see the overall configuration of the machine. Figure 3 show the conceptual design of the machine (as sketched by internship student).

Based on the design, only 1 mechanism involve instead of 3 for conventional machine. The mechanism is the worktable. As the part need to be positioned and move manually. The x-y-z table equipped with locking system. Therefore, for z-axis, after confirming the feed rate, it can be locked to ensure flatness of the grinded surface.

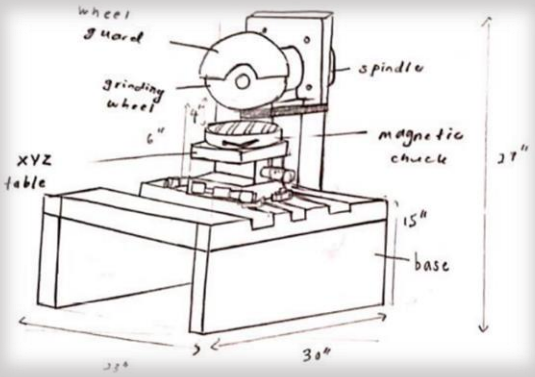

Figure 3

The only challenging issue is on the rigidity and integrity of the x-y-z table. Since the table moves manually, those properties are critical not only to ensure smoothness of the movement but also accuracy of the machining.

The horizontal base is equipped with T-slot, so that easier for other part or compartment to attach on the base. This is common to most of the machine. It's allows for flexibility and strength when mounted parts.

Conclusions
As a conclusion, the article presented a conceptual design of the mini surface grinding machine with table-top size for the purpose of preparing a small, thin and rough surface specimen made by metal additive manufacturing like MIG and TIG. Next is the construction of the CAD model, before it can be fabricated. From the CAD files, all details about each part can be further tested and finalized.

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