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Inside the Issue

Preface.....1
Research Seminar.....1
Photo.....1
Abstract.....2

Recent Publications

Accepted

1. Adnan, M. F., Abdullah, A. B. and Samad, Z. "*Experimental Investigation of Springback Pattern of Non-uniform Thickness Section*", Journal of Mechanical Engineering and Sciences (JMES). Published by Universiti Malaysia Pahang.
2. Jaafar, N. A., Abdullah, A. B. Abdullah and Z. Samad, "*Optimization of WEDM cutting parameters on surface roughness of 2379 steel using Taguchi Method*", SAE International Journal of Materials and Manufacturing. Published by SAE International.

Active Grants

Title: Formability analysis of tailor welded blanks of steel and aluminium alloys.
RUI (2018 – 2020)

Preface

Alhamdulillah, the group managed to organized research seminar for the first time after few postponements. Thank you to the participants who able to not give the best not only during the presentation but also in ensuring the program run smoothly. There are still many aspects to be improved such as better promotion to increase crowd and obtaining ISBN number as an academic recognition to the presented work.

MFRL is in planning to enhance the level of the seminar by involving more participants. This year only few group members participated, while in the next year colleague from other university will be invited. Hoping from the seminar not only create networking but also become effective group advertisement.

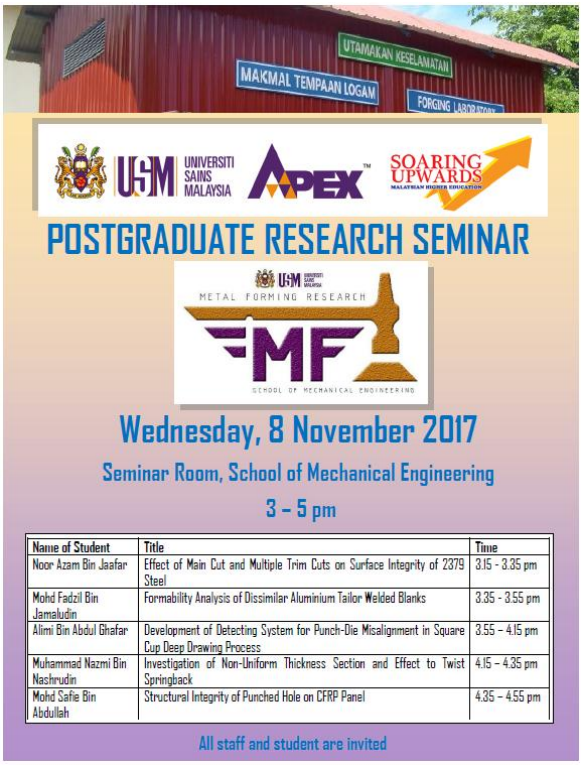
The detail of the seminar is as follow;

Title of the Seminar: National Postgraduate Seminar on Metal Forming and Tooling Design

Expected Date: July 2018

Venue: School of Mechanical Engineering, Universiti Sains Malaysia Engineering Campus.

Research Seminar



Name of Student	Title	Time
Noor Azam Bin Jaafar	Effect of Main Cut and Multiple Trim Cuts on Surface Integrity of 2379 Steel	3.15 - 3.35 pm
Mohd Fadzil Bin Jamaludin	Formability Analysis of Dissimilar Aluminium Tailor Welded Blanks	3.35 - 3.55 pm
Alimi Bin Abdul Ghafar	Development of Detecting System for Punch-Die Misalignment in Square Cup Deep Drawing Process	3.55 – 4.15 pm
Muhammad Nazmi Bin Nashrudin	Investigation of Non-Uniform Thickness Section and Effect to Twist Springback	4.15 – 4.35 pm
Mohd Safie Bin Abdullah	Structural Integrity of Punched Hole on CFRP Panel	4.35 – 4.55 pm

Photo

Contact Details

Metal Forming Research Laboratory, School of Mechanical Engineering, Engineering Campus Universiti Sains Malaysia Seri Ampangan
14300 Nibong Tebal, Pulau Pinang, MALAYSIA, Phone: 604-5996332, Fax: 604-5996912, e-mail: mebaha@usm.my, http://metalforming.usm.my

Title: Effect of Main Cut and Multiple Trim Cuts on Surface Integrity of 2379 Steel
Name: Noor Azam Bin Jaafar (PhD)

Producing precisions dies is important in tool and dies industry to produce good quality product. Sharpness of the die edge is one of the important element needs to be emphasized during die fabrication for ensuring precise shearing. In addition, satisfied surface integrity also needs to consider for die surface finish to extend the tool life. Typically, Wire Electrical Discharge Machine (WEDM) is used in the die making as the material is considered as hard and difficult to machine material. However, thermal effect of the WEDM machining process can cause the surface defect such as formation of white layer or recast layer at the machined surface. The defect will affect the hardness of the machined surface and thus influence the performance of tool life. Furthermore, there are many parameters need to be considered including WEDM cutting parameters, die design parameters and punching process parameters and selection of optimal combination of these parameters become more crucial and challenging. In this study, 2379 steel which owns properties equivalent to SKD 11 but cheaper was used as die material. Four main WEDM cutting parameters, namely pulse duration (A), pulse interval (B), servo voltage (C), ignition pulse current (D), have been experimentally studied and optimized at both levels, main cut and multiple trim cuts using Taguchi Method. Taguchi's L9 orthogonal array is employed for experimental design and analysis of variance (ANOVA) has been used in recognizing levels of significance of WEDM cutting parameter. The result found that pulse duration and pulse interval gives significant effect on white layer thickness for both main cut and multiple trim cuts. According to Signal to Noise (S/N) ratio response, the optimal combination of A1B3C2D1 and A1B3C3D1 gave the lowest white layer thickness for main cut and multiple trim cuts respectively. It also has been found that the hardness of the machined surface with multiple trim cuts is higher compared to main cut. The optimal combination of the identified WEDM cutting parameters will be used in the fabrication of the punching die.

Title: Formability Analysis Of Dissimilar Aluminium Tailor Welded Blanks
Name: Mohd Fadzil Bin Jamaludin (PhD)

Dissimilar sheet metal components are potentially useful in lightweight and multifunctional applications. These components are produced from welded dissimilar metal blanks, also known as tailor welded blanks (TWB). Their dissimilarity is in term of sheet thickness or different alloys. Such technology is important in the automotive industry, where metal formed component account for more than 85% (by weight) of the parts in an automobile. The adoption of light metals, such as aluminium, is near-term solution for light-weighting, and the use of aluminium welded TWB provide further potential for weight reduction. However, the capacity to rapidly join dissimilar aluminium sheet of dissimilar thickness and alloys, and characterization of post-weld formability has yet to be fully developed. The objective of this research is to determine the formability of TWB made from combinations of different thickness and grades of aluminium alloys. Since formability is fundamental for metal forming work, there is a need to derive the forming limit diagrams (FLD) of these TWBs. The joining and formability of dissimilar alloy combination remains a significant challenge, due to the differences in mechanical and material properties. In addition to the differences in material properties inherited from the parent materials, dissimilar joints would also possess additional characteristics due to their production process, such as the presence of heat affected zones and intermetallic compounds, that may influence their strength and formability. Existing forming limit diagram of the parent materials could not be used for forming dissimilar material joined specimens. To be able to utilize dissimilar aluminium TWBs in forming applications, it is therefore necessary to derive the forming limit diagram (FLD) specific to the alloy combinations and welding process used. It is hypothesized that the selection of material combinations, sheet thickness and the joining parameters used, and the presence of welding resultant effects (such as heat affected zones and intermetallic compounds) would influence the forming limit diagram (FLD) of dissimilar aluminium tailor welded blanks.

Title: Development of Detecting System for Punch-Die Misalignment in Square Cup Deep Drawing Process
Name: Alimi Bin Abdul Ghafar (PhD)

Deep drawing is a forming process of sheet metal through a hollow vessel using a specific punch without fracturing, excessive thinning and wrinkling. Irregular shell of deep drawing product requires more consideration compare to circular shell in which pressure uniform on all diameters. Alignment between punch and die in deep drawing process (DDP) is a critical factor should be considered to avoid undesired defect especially excessive thinning that can contribute to tearing condition. In this study, vision system will be applied to detect misalignment of punch and die for square cup DDP. Finite element (FE) for related model also will be deployed using ANSYS for comparison purpose. The commercial aluminium alloy AA1100 with thickness 1mm is used for this study. Significance parameters to tearing contribution namely punch speed, blank holder force and die design parameters (geometrical parameters) were determined properly to minimize noise of study. Meanwhile, responses such as drawing punch force produced and thickness distribution of material are measured to determine the severity effect due to misalignment condition. This presentation will focus on related literature study (significance of study), method for detecting misalignment, designing the system and current progress of study.

Title: Investigation Of Non-Uniform Thickness Section And Effect To Twist Springback
Name: Muhammad Nazmi Bin Nashrudin (MSc)

Lighter vehicles are one of the main concerns for automotive manufacturer to achieve for. There are many numerous techniques have been implemented to accomplish this objective. One of the effective approaches is by using part with thickness variation. The formability of the non-uniform thickness section is different compare to uniform thickness due to the strain hardening effect. Severe defect may occur if there are improper process and incorrect decision were conducted during forming and one of the main concerns is springback. Among the three types of springback, twist springback is the most difficult to be predicted compared to the others. Twist rail and S-rail represent the vehicle parts that exhibit twist springback. The elastic recovery of a strip upon removal of twist loading produced twist springback and cause the final shape deviates from the expected one. This study investigates the twist springback of non-uniform thickness section since uniform thickness section already covered by many studies. Twist springback is modeled using static structural analysis in ANSYS Workbench software. The parameters considered are twist angle, material type and thickness ratio. Then, the twist springback angle is measured by utilizing graphical method available in the MATLAB software. Typical non-uniform thickness profiles including flat, tapered, stepped, convex and concave were modeled. From the result, twist springback is become higher as the thickness ratio is lower. Similarly, for twist angle, as it is increased, the twist springback decreased. In addition, material with lower Young's modulus will result to higher twist springback. In conclusion, all of the studied parameters found to be significant to the twist springback. For validation, experiments on flat and tapered profiles were performed and the result agreed with the simulation.

Title: Structural Integrity of Punched Hole on CFRP Panel
Name: Mohd Safie Bin Abdullah (MSc)

Mechanical joints in composite structure are broadly used in many applications due to its accessible in disassembly for maintenance. The capability of the mechanical joints (bolted joint, pin joints, rivet joints and etc) depends on the holes quality since the load transmitted via fastener give rise to stress concentration around the hole-fastener boundary. This paper presents the experimental study on the effect of holes preparation technique punching on carbon fiber reinforced polymer (CFRP) with constant geometry parameters to the bearing strength and the progressive failure analysis of the hole under tensile loading. A bearing test was conducted according to ASTM D5961 Procedure A double shear with single-pin fastener using modified fixture. The progressive failure modes resulting from experiment are quantified and compared to literature. It was found that, there is a clear difference in bearing response profile plotted in load-displacement graph between drilling and punching technique.