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Recent Publications

1. H. Vairavan and A.B. Abdullah, *"Die–Punch Alignment and Its Effect on the Thinning Pattern in the Square-Shaped Deep Drawing of Aluminum Alloy"* International Journal of Materials and Product Technology, Vol. 54(1/2/3), 2017, pp. 147-164. (IF 2015 = 0.365 Q4).
2. M. F. Adnan, A. B. Abdullah and Z. Samad, *"Effect of Annealing, Thickness Ratio and Bend Angle on Sspringback of AA6061-T6 with Non-uniform Thickness using Taguchi Method"*, MATEC Web of Conferences 90, 01002, 2017. (Scopus)
3. Md. Tasbirul Islam, A.B. Abdullah and Mohamad Zihad Mahmud, *"Reverse Engineering of B-Pillar with 3D Optical Scanning for Manufacturing of Non-Uniform Thickness Part"*. MATEC Web of Conferences 90, 01007, 2017. (Scopus)
4. M. N. Nashrudin and A. B. Abdullah, *"Finite Element Simulation of Twist Forming Process to Study Twist Springback Pattern"*, MATEC Web of Conferences 90, 01026, 2017. (Scopus)

Active Grants

Title: Modeling of Twist Springback Pattern of Aluminum Alloy Strip with Non-Uniform Section.
FRGS (2014 – 2017)
Title: Precision Punching of Composite Panel
RUI (2015 – 2017)

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Preface

Congratulation to the editorial board for the launching of the first edition of the MFRL Bulletin. By having this medium, hopefully the group's name will spread national and internationally. Planning for having this publication comes in mind for quite some time ago. Only now it can be realized. The metal forming laboratory or MFRL is actually initiated since 2006, but till 2013 it run in passive mode. Constraint with less funding without research student, limit the progress of the group. Even though the area has lots of potential and opportunity for research collaborations and projects, without student it cannot go anywhere. MFRL stands for Metal Forming Research Laboratory, and our main research objective is to serves metal forming industries and shares the knowledge discovered from the research carried out in solving problem.

Group Activity

Factory Visit

Three companies have been visited for the last two months, Solid Precision Engineering Sdn Bhd located at Sungai Petani, Kedah, AEL Engineering Sdn Bhd located at Parit Buntar, Perak and Coraza System Sdn Bhd located Nibong Tebal, Penang. The objective of the visit mainly to seek for potential collaborations in the metal forming process, as they are among the key players in the northern region.

AEL ENGINEERING

SOLID PRECISION ENGI

CORAZA SYSTEM

Monthly Meeting

As usual, monthly meeting will be used as a platform to report update of the student's progress. Beginning from January 2017, one of the students will give an opportunity to present his/her progress.

Achievement

One of the members (Mohd Fitri Adnan) had successfully gone through his viva-voce on the 7th of December 2016. Congratulation to him for this achievement. Now he is working with Department of Vocational as a teacher. Good luck for his career.

Research Summary 1

Name: Alimi Abdul Ghafar (PhD)
Title: Development of Monitoring system for measuring and detecting part defect due to die-punch misalignment in the deep drawing process.

Misalignment is one of major concern in deep drawing process, because it may become unexpected cause of product defect. Many of the previous studies were using a lab-test apparatus that involve complex setup, expensive high-tech equipments and devices and most importantly require highly competent personal to handle and maintenance the system. The developed systems were difficult to be implemented in the real production. To date, there is no affordable system that practically can be utilized especially by small and medium industry (SMI) to improve their production in detecting and measuring the defect. Thus, for this project, misalignment due to imbalance axial between punch and die will be the major consideration for this project. At the end of the project, the developed system will be implemented in the factory to improve their productivity.

Research Summary 2

Name: Noor Azam Jaafar (PhD)
Title: Optimization of WEDM machining parameter for improving die edge on punching die

Sharpness of the die edge in punching process is very important to ensure quality of produced product. Typically, wire-EDM cutting operation is the most common method to produce the die. Various interrelated parameters will influence the process beginning from the machining parameters during fabrication of the die, the design parameters of the die and also process parameters when die is using during punching process. Usually researcher will only study one of the parameters. In this project, all these parameters will be experimentally studied and optimized using Taguchi method. The machining parameters considered are pulse on time (A), pulse off time (B), servo voltage (C), ignition pulse current (D), and dielectric pressure (E). While the design parameters that going to be studied are angle of cutting, die clearance and size of the hole. In addition, the process parameters are lubrication, speed of the punching, material type and thickness of the material. Optimization are based various response such as wear of the die.

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

New Technology on Holes Making of CFRP Panels using Punching Process.

A. B. Abdullah*, M. S. M. Zain, H.Y. Chan. Abdullah and Z. Samad
School of Mechanical Engineering, Universiti Sains Malaysia, 14300 Nibong Tebal, Pulau Pinang, MALAYSIA. Phone: 604-5996332, Fax: 604-5996912, email: mebaha@usm.my

ABSTRACT- Assembly for a structural material such as composite panel cannot be avoided. Typically, composite panels are assembled using a fastener through a drilled hole. The main problem of drilling is delamination, which affects the strength of the assembly. In addition, the cost of drilling is high because of repeating regrinding of the drill bit. The main goal of this research is to develop a new method as an alternative to hole drilling. In this study, a method to assess the produced hole based on profile measurement technique will be developed. The effect of the die clearance and punch profile to the quality of the hole including the roundness, strength and delamination will be carried out. Comparison to the developed measurement method will be performed for validation.
Keywords: composites panel, punching, delamination, structural integrity

Introduction

Composite materials are now widely used to replace certain metals in manufacturing applications, particularly in the aerospace industry [1-2]. These materials are used mainly because of their light weight, reliability, and strength, especially in critical and high-precision applications. The assembly of composite structures as structural materials cannot be avoided. Mechanical joint efficiency is largely dependent on the quality of produced holes. The evaluation of the quality of drilled fastener holes must include the general geometry of the hole and the condition of the hole surface. Therefore, the quality of the hole can be characterized on the basis of a few criteria, including delamination factor, out-of-roundness, cut neatness, and surface roughness [3-5]. Delamination can decrease bearing strength and material durability by reducing the structural integrity of the material, resulting in long-term performance deterioration [4]. Mechanical fastening efficiency is largely dependent on the precision and accuracy of drilled holes. Therefore, out-of-roundness, cut neatness, and holes edge quality are crucial.

Result and Discussion

The experiment will be conducted at punch travel speed of 5 mm/s. The punch was installed at the crosshead, whereas the die was placed at the bottom (Fig. 1). This may act a blank holder to grip the sample. The tests were repeated at least three times for each studied parameters. The produced holes images need to be the captured and then analyzed. Two different color patterns represent topography (rise or sunken) of the surface resulted from the punching process, which can be seen in Fig. 2. The gained profile clearly shows the affected and non-affected area around the hole due to punching process. Based on Table 1, the results of the comparison generated through Alicona IFM are different to a certain extent from the results generated using a machine vision system. These samples are for the 10.00 mm diameter puncher with 1% die clearance. For comparison, the diameter of the hole on the entry was taken as reference. The largest difference observed on the diameter difference between entry and exit can be found on sample 5i.e.0.461 mm or 4.68%. While, the other results were between ~0.5% and +2.8%. These results suggest that the new hole making method is acceptable because the difference between the size of holes at entry and exit are considerably low. Fig. 3 show further investigation of the diameter difference at various puncher diameters and die clearance. In this result, the die clearance of 1% is tested on 5 mm and 10 mm puncher diameter only. Based on this observation, the quality of the produced holes is still within acceptable level. With regard to the delamination, the changes in the die clearance did not exhibit a common pattern, i.e. size of the affected area. Based on Fig.4, increasing the die clearance from 1% to 10% will depicted increment in the delamination. After further increase 25% and 30%, the delamination was reduced. However, after 35% of the die clearance, the delamination was suddenly increased.

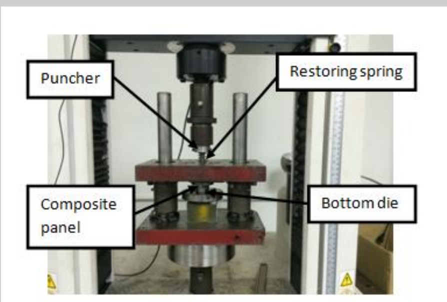

Figure 1. Experimental Setup.

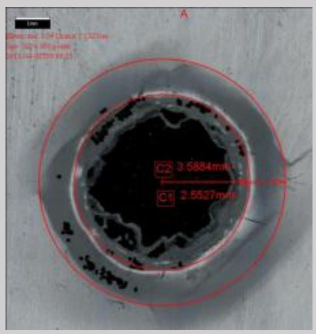

Figure 2. The image of scanned hole and affected area due to punching.

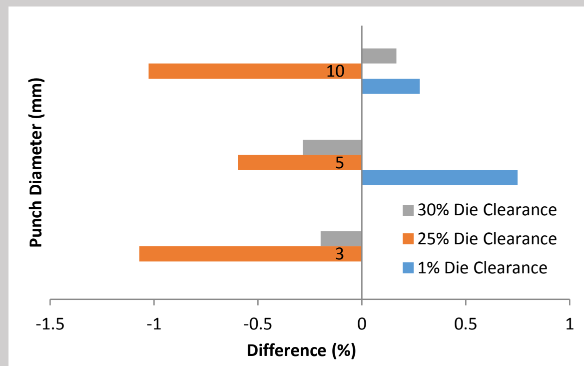

Figure 3: Delamination factor for difference die clearance, blue – present, orange – Chen, 1994.

Table 1: Measurement data obtained from KLONK and Alicona IFM

Specimen	Alicona IFM (Diameter, mm)		KLONK (Diameter, mm)		Difference in Diameter (%)	
	Entry	Exit	Entry	Exit	Entry	Exit
Sample 1	10.162	10.233	10.078	10.253	0.83	-0.19
Sample 2	10.159	9.958	10.077	9.796	0.81	1.62

Conclusions

Main objective of this project was to evaluate the quality of holes through punching operation. The compressive stress and maximum compressive load increased as the die clearance (die diameter) decreased. For the same clearance, the puncher with a larger diameter had higher compressive stress and maximum compressive load. To produce Ø10 and Ø5 mm holes with favorable cut surface quality and dimensional accuracy, the bottom die clearance value needed to be minimal because the bottom surface diameter of a hole tended to be close to the bottom die diameter. The dual-stages punching mechanism reduced the effect of die clearance on the maximum compressive load.

Acknowledgement

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References

[1] E.C. Botelho, R.A. Silva, L.C. Pardini and M.C. Rezende. 2006. Material Research. 9(3): 247-256.
[2] T. Edward, 2008. Ingenia. 36: 24-28.
[3] I.S. Shyha, S.L. Soo, D.K. Aspinwall, S. Bradley, R. Perry, P. Harden and S. Dawson. 2011. International Journal of Machine Tools and Manufacture. 51(7–8): 569–578.
[4] S.Arul, L. Vijayaraghavan, S.K. Malhotra and R. Krishnamurthy. 2006. International Journal of Machine Tools and Manufacture. 46(3–4): 252–259.
[5] D. Kim, P. Kwon, J. Lantrip, A. Beal, et al., 2010. SAE Technical Paper 2010-01-1868. doi:10.4271/2010-01-1868.
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