Materials Science Forum
Key Engineering Materials
Solid State Phenomena
Defect and Diffusion Forum
Diffusion Foundations
Applied Mechanics and Materials
Advanced Materials Research
Advances in Science and Technology
Journal of Nano Research
Journal of Biomimetics, Biomaterials and Tissue Engineering
Journal of Biomimetics, Biomaterials and Biomedical Engineering
Journal of Metastable and Nanocrystalline Materials
International Journal of Engineering Research in Africa
Advanced Engineering Forum
Nano Hybrids

Home > Applied Mechanics and Materials

Periodical: APPLIED MECHANICS AND MATERIALS
ISSN: 1662-7482
Details

Main Themes published in this Periodical:

Search Volume Or Title

1 2 3 4 5 ... > >>

Showing 1 to 10 of 430 Main Themes

1 2 3 4 5 ... > >>

Scientific.Net is a registered brand of Trans Tech Publications Inc.

2015 by Trans Tech Publications Inc. All Rights Reserved

LEMBAR PENGESAHAN

Judul : FEM Simulation of Machining AISI 1045 Steel Using Driven Rotary Tool

Penulis :
1. Yanuar Burhanuddin (NIP. 19640506 200003 100 1)
2. Suryadiwansa Harun (NIP. 19700501 200003 100 1)
3. Gusri Akhyar Ibrahim (NIP. 19710817 199802 100 3)

Instansi : Fakultas Teknik, Universitas Lampung

Publikasi : Jurnal Internasional, Applied Mechanics and Materials

: ISSN. 1662-7482

: Vol. 758, Hal.77-82 , Tahun 2015
http://www.scientific.net/AMM.758.77

Penerbit : Trans Tech Publications Inc, Churerstrasse 20, CH-8808 Pfaffikon, Switzerland, Phone +41 44 922 10 22 / Fax +41 44 922 10 33, info@scientific.net or info@tpp.net

Bandar Lampung, 20 Maret 2015

Mengetahui,
Dekan Fakultas Teknik
Universitas Lampung

Prof. Drs. Suharno, M.Sc., Ph.D
NIP. 196207171987031002

Penulis Utama,

Dr. Yanuar Burhanuddin
NIP. 196405062000031001

Menyetujui:

Ketua Lembaga Penelitian dan Pengabdian Kepada Masyarakat
Universitas Lampung

Dr. Eng. Admi Syarif.
NIP. 196701031992031003

DOKUMENTASI LEMBAGA PENELITIAN UNIVERSITAS LAMPUNG

TGL	31 Maret 2015
NO. INVEN	35/04/26/8/LPPM/2015
JENIS	Jurnal Internasional
PARAF	

IDENTITAS PENULIS

NIP	197005012000031001
Nama .	Dr. Eng. Suryadiwansa Harun
E-mail	suryadiwansa.harun@eng.unila.ac.id
Fakultas	Teknik
Jurusan	Teknik Mesin
Peer Group	Teknik Produksi dan Manufaktur
Golongan/Pangkat	Penata Tk I/IIID
Jabatan Fungsional	Lektor
Pendidikan Sarjana (S1) :	
-- Universitas	Institut Teknologi Sepuluh Nopember Surabaya (ITS)
-- Gelar	Sarjana Teknik, S.T
-- Tahun Selesai	1997
Pendidikan Magister (S2) :	
-- Universitas	Institut Teknologi Bandung (ITB)
-- Gelar	Magister Teknik, M.T
-- Tahun Selesai	2001
Pendidikan Doktor (S3) :	
-- Universitas	Kobe University
-- Gelar	Doctor of Engineering, Dr.Eng.
-- Tahun Selesai	2009

SJR SCImago Journal & Country Rank

EST MODUS IN REBUS
Horatio (Satire 1,1,106)

Home
Journal Rankings
Journal Search
Country Rankings
Country Search
Compare
Map Generator
Help
About Us

Journal Search

Search query

in Journal Title Search

Exact phrase

Applied Mechanics and Materials

Country: Germany

Subject Area: Engineering

Subject Category:

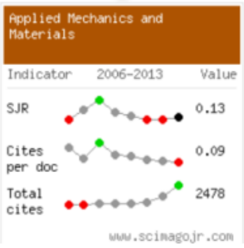
Category	Quartile (Q1 means highest values and Q4 lowest values)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Engineering (miscellaneous)								Q3	Q2	Q2	Q3	Q3	Q4	Q4	Q3

Publisher: Trans Tech Publications. **Publication type:** Book Series. **ISSN:** 16609336, 16627482

Coverage: 2005-2014

H Index: 11

Show this information in your own website



Charts Data

SJR indicator vs. Cites per Doc (2y)

Materials Science Forum
Key Engineering Materials
Solid State Phenomena
Defect and Diffusion Forum
Diffusion Foundations
Applied Mechanics and Materials
Advanced Materials Research
Advances in Science and Technology
Journal of Nano Research
Journal of Biomimetics, Biomaterials and Tissue Engineering
Journal of Biomimetics, Biomaterials and Biomedical Engineering
Journal of Metastable and Nanocrystalline Materials
International Journal of Engineering Research in Africa
Advanced Engineering Forum
Nano Hybrids

Home > Applied Mechanics and Materials > Details

Periodical: APPLIED MECHANICS AND MATERIALS

ISSN: 1662-7482

About:

Applied Mechanics and Materials publishes only complete volumes on given topics, proceedings and complete special topic volumes. Thus, we are not able to publish stand-alone papers.

Applied Mechanics and Materials specializes in the rapid publication of proceedings of international conferences, workshops and symposia as well as special volumes on topics of current interest in all areas related to (1) research and development of machines and mechanisms; (2) materials engineering and technologies for production and processing; (3) systems of control and automation for manufacturing in the areas of industrial production and other related engineering sciences.

Authors retain the right to publish an extended, significantly updated version in another periodical.

Indexing: Volumes are submitted for indexing to Elsevier: SCOPUS www.scopus.com and Ei Compendex (CPX) www.ei.org/. Cambridge Scientific Abstracts (CSA) www.csa.com, Chemical Abstracts (CA) www.cas.org, Google and Google Scholar google.com, ISI (ISTP, CPCI, Web of Science) www.isinet.com, Institution of Electrical Engineers (IEE) www.iee.org, etc.

Publishing editor: Thomas Wohlbier, TTP USA, t.wohlbier@ttp.net

Subscription: Irregular: approx. 150-200 volumes per year.

The subscription rate for web access is EUR 1089.00 per year.

Standing order price: 20% discount off list price

ISSN print 1660-9336 ISSN cd 1660-9336 ISSN web 1662-7482

Editors: Editorial Board

Share:

Main Themes published in this Periodical

Scientific.Net
Materials Science and Engineering
Scientific.Net is a registered brand of Trans Tech Publications Inc.
2015 by Trans Tech Publications Inc. All Rights Reserved

Periodical: APPLIED MECHANICS AND MATERIALS
ISSN: 1662-7482

Editorial Board:

Editors

Publishing Editor Mr. Wohlbier, T.
105 Springdale Lane, Millersville, USA, PA 17551;

Professor Xu, X.P.
Huaqiao University, Ministry of Education Engineering Research Center for Brittle Materials Machining; Xiamen, China, 361021;

Editorial Board

Professor Cadoni, E.
University of Applied Sciences of Southern Switzerland, Dynamat Laboratory; Via Trevano P.o. Box 12, Canobbio, 6952, Switzerland;

Professor Cheng, Y.S.
Harbin Institute of Technology, School of Materials Science and Technology; P.O. Box 435, Harbin, China, 150001;

Professor Chinakhov, D.A.
Yurga Institute of Technology of National Research Tomsk Polytechnic University; Leningradskaya Street, 26, Yurga, Russian Federation, 652055;

Professor Delgado Sobrino, D.R.
Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava; Bottova 25, Trnava, 917 24, Slovakia;

Professor Dodun, O.
Gheorghe Asachi Technical University of Iaşi, Department of Machine Manufacturing Technology; D. Mangeron Blvd, 39A, Iaşi, 700050, Romania;

Professor Gogu, G.
Clermont Université, Pascal Institute; UMR 6602 CNRS/UBP/IFMA, BP10448, Clermont-Ferrand, F-63000, France;

Professor Hajduk, M.
Technical University of Kosice, Department of Production Systems and Robotics, Faculty of Mechanical Engineering; Letná 9, Kosice, 042 00, Slovakia;

Professor Karama, M.
Université de Toulouse, INPT - Ecole Nationale d'Ingénieurs de Tarbes (ENIT), LGP (Laboratoire Génie de Production); 47 Avenue d'Azereix, BP1629, Tarbes Cedex, 65016, France;

Professor Koukolová, L.
Technical University of Kosice, Faculty of Mechanical Engineering, Department of Production Systems and Robotics; Nemcovej 32, Kosice, 042 00, Slovakia;

Professor Krenický, T.
Technical University of Košice, Department of Technical Devices Design; Štúrova 31, Prešov, 08001, Slovakia;

Professor Lucas, M.
University of Glasgow, Department of Mechanical Engineering; Glasgow, United Kingdom, G12 8QQ;

Professor Meor, Y.M.S.
Malaysian Nuclear Agency Bangi, Materials Technology Group (MTEC), Industrial Technology Division; Kajang, Malaysia, 43000;

Professor Olaru, A.
Politehnica University of Bucharest; Splaiul Independentei 313. Sector VI, Bucharest, 060042, Romania;

Professor Semanco, P.
TU Kosice, Faculty of Manufacturing Technologies; Bayerova 1, Presov, 08001, Slovakia;

Professor Syed-Khaja, A.

Professor Uhl, T.
AGH University of Science and Technology, Department of Robotics and Mechatronics, Faculty of Mechanical Engineering and Robotics; Al. Mickiewicza 30, Krakow, 30-059, Poland;

Professor Zulkifli, R.
Universiti Kebangsaan Malaysia, Department of Mechanical and Materials Engineering, Faculty of Engineering and Built Environment, Centre for Automotive Research, Faculty of Engineering and Built Environment; Bangi, Malaysia, 43600;

Main Theme: MECHANICAL ENGINEERING AND APPLIED MECHANICS

Volume 758
doi: 10.4028/www.scientific.net/AMM.758

Paper Titles published in this Title

Applied Mechanics and Materials Vol. 758 (2015) pp 77-82
© (2015) Trans Tech Publications, Switzerland
doi:10.4028/www.scientific.net/AMM.758.77

Submitted: 30.10.2014
Accepted: 17.11.2014

FEM Simulation of Machining AISI 1045 Steel Using Driven Rotary Tool

Yanuar Burhanuddin, Suryadiwansa Harun, Gusri Akhyar Ibrahim

Department of Mechanical Engineering, University of Lampung, Lampung – Indonesia

Email: yanuar.burhanuddin@eng.unila.ac.id

Keyword: driven rotary tool, tool rotational speed, force, temperature

Abstract.This study investigates the influences of driven rotary tool (DRT) on temperatures and forces when turning AISI 1045 steel. A set of cutting conditions was used in FE simulations to predict cutting force, stresses and temperatures developed at around the edge of tool. The material cutting speed ranges were set between 20 and 250 m min^{-1}. The rotary tool speed were 0 and 100 rpm. The feed rate and the depth of cut were set constant. Simulation results provided the predicted cutting distribution of temperatures and stresses at the chip and work piece.

Introduction

Machining of high strength steel using conventional cutting is very difficult and time consuming. During machining takes place, temperature and pressure will arise, this will lead to hardening due to the deformation or phase change of the materials. Therefore, instead of using conventional cutting cutting tool, machining of high-strength steel using a driven rotary tool may provide a better solution.

Rotary tool turning is a cutting process in which the cutting edge of a round insert rotates its axis, so that a continously indexed cutting edge is fed into the cutting zone [1]. There are two types of rotaty tool, self-propelled rotary tool (SPRT) and driven rotary tool (DRT). The difference between these two types is an auxillary drive unit to rotate the driven tool [2]. In SPRT, tool rotates due to the rotation of the workpiece while the DRT, the tool rotates due to driver motor. Self-rotation of a knife during machining process appears under influence of friction forces which appear in the point of contact of tool flank surface and machined surface. In the case of when angle $\alpha=0°$ then the knife during machining doesn't rotate but when angle $\alpha\neq0°$, a substantial contribution to self-rotation of knife has friction of a moving chip on the rake face [3].

In the rotary cutting tool, round inserts mounted on the tool holder will spin when engagement of the workpiece and the cutting tool. Because the rotary movement of the tool, the wear and heat will be distributed uniformly around the inserts. Uniform distribution of heat and wear at the cutting zone between the inserts and the workpiece will keep the temperature at an acceptable level. Thus hardening deformation or phase transformation can be avoided [1].

To obtain the characteristics of the rotary machining process, reseachers require a lot of machining experiments. The vast machining experiments require a lot of cost and time. This gives an idea to the researchers to use finite element analysis. Investigators prefer the finite element analysis compared the experimental work because it can save time and costs [4].

Research of machining process simulation using rotary cutting tool is very rare. Until now none of literature on researches of rotary tool machining is reported. Most of the machining simulation researches are non-rotary tool machining simulation. There are many unknown phenomena in the rotary tool machining such as temperature distribution, tool wear, tool/workpice stress and workpiece surface integrity. In this study a finite element is applied to simulate AISI 1045 steel machining using rotary tool. The aim of this study is to determine temperature distribution in the work-piece, tool and chip and cutting force in turning process. The model is based on unsteady state machining condistion. AISI 1045 steel were turned under various cutting conditions. Various cutting conditions are cutting speed, feed rate, depth of cut and tool rotational speed.

All rights reserved. No part of contents of this paper may be reproduced or transmitted in any form or by any means without the written permission of TTP, www.ttp.net. (ID: 103.3.46.247-07/03/15,09:27:34)

Finite Element Modeling

The first step in finite element simulation of rotary tool machining is to establish the tool geometry. This geometry model including rake angle, relief angle and tool diameter as shown in Fig 1. The next step is to establish the finite element model of rotary tool turning. The finite element model of rotary tool is made based on the kinematic model of rotary turning. Kinematic and finite element model of rotary tool turning were illustrated in Fig 2a & b.

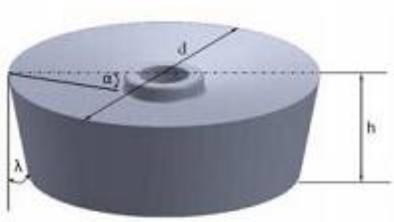
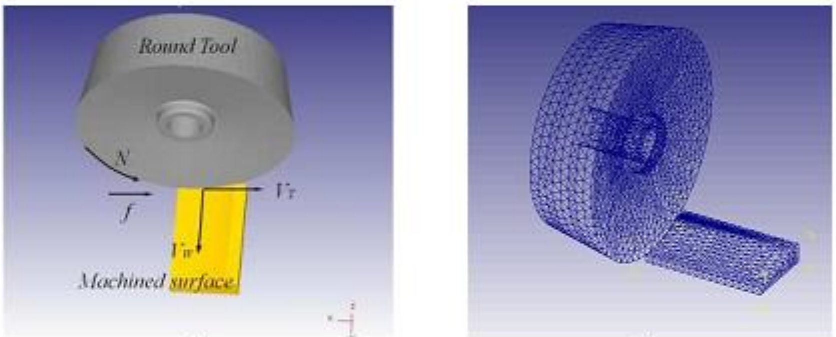


Fig 1. Tool geometry model (d=tool diameter, h=tool thickness, α=rake angle, λ=clearance angle)



(a) (b)

Figure 2 (a) Kinematic modeling of rotary tool, (b) Meshing of rotary tool turning

Finite element software was used to simulate the metal cutting process. It is based on the Updated Lagrangian formulation. This software is used to simulate machining parameters in a turning process of AISI 1045 carbon steel. Workpiece was assumed as plastic, whereas the tool was assumed as a rigid. The transfer of heat was taken into account to the modeling of cutting temperature.

Simulation process was done by varying the cutting speed, feed, depth of cut and tool rotation speed. The machining parameters is shown in Table 1, while the type and geometry of material and tool are shown in Table 2.

Table1. Machining parameters in simulation

Tool rotary speed N, Rpm	0 ~ 3000
Workpiece cutting speed VW, m/min	60 ~160
Feed, mm/rev	0.1;0.2
Depth of cut a, mm	0.5
Inclination angle, deg	0°
Offset angle θ, deg	0

Table 2. Material type and cutting tool geometry

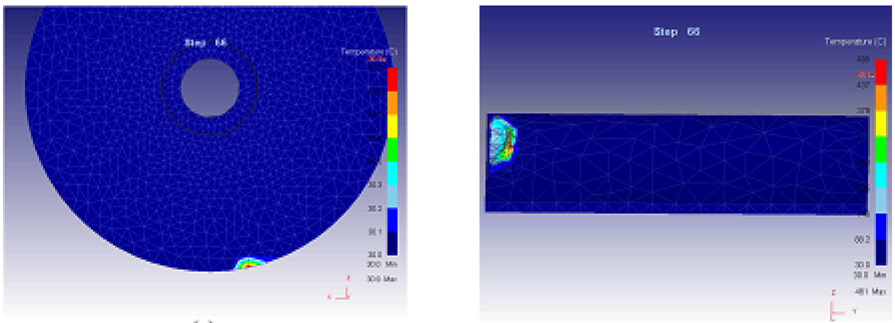
Workpiece	
Material type	Plain Carbon Steel (AISI 1045)
Material dimension	Diameter 50 mm
Round Tool Insert	
Material	Uncoated tungsten carbide, WC-Co
Geometry	Jenis RPMT 1604 MO-BB (Kyocera)
Relief angle	α=11°C
Diameter	D=16 mm

The results of force and temperature on tool and workpiece would be analyzed. The initial temperature of the workpiece and the tool was set to 20 °C. Simulation was carried out until achieved a steady state condition to allow the flow of heat into the workpiece, tool and chip. Results and values observed on the tool and workpiece would be taken into account after the complete simulation.

Result and Discussion

The results from the turning process simulation using rotary cutting tool were analyzed after the complete simulation. There are two aspects to be analyzed namely cutting temperature and cutting force. Of the total energy consumed in machining, nearly all of it (approximately 99%) is converted into heat [5]. The heat was distributed between three areas namely tool, workpiece and chip during the machining process. A significant proportion of the cutting energy is carried off with the chip hence the chip temperature usually higher than two other areas. The temperature distribution on the interface of the tool-workpiece is illustrated in Fig 3a. While the temperature distribution on the chip where the largest temperature observed in this area is shown in Fig 3.b.

The results of the tool rotational speed effect on the machining temperature and cutting force are shown in Table 3 and Table 4. Table 3 contains the effect of tool rotational speed on the tool-workpiece interface temperature and chip temperature. Table 4 contains the effect of tool rotational speed on the main cutting force. In both tables it can be seen that the temperature and cutting force at lowest value when machining at tool rotational speed of 35 m /min. Therefore based on the value of tool cutting speed 35 m/min, the prediction of the effect of workpiece cutting speed on the cutting force and chip temperature will be simulated.



(a) (b)

Fig. 3 (a) temperature distribution on the interface of the tool-workpiece, (b) temperature distribution on the chip

Table 3 The effect of tool rotary speed variation to tool-workpiece interface and chip temperature (Machining condition: V_w=150 m/min, f=0.2 mm/rev, a = 1 mm, i = 0, θ = 0, and dry)

No	Tool rotation speed		Cutting temperature	
	N, Rpm	VT, m/min	Tool-workpiece interface, °C	Chip, °C
1.	0	0	432	787
2.	50	2.5	384	755
3.	100	5.0	377	724
4.	200	10	371	708
5.	300	15	392	716
6.	500	25	389	711
7.	650	32.5	347	752
8.	700	35	332	737
9.	750	37.5	324	689
10.	800	40	371	742
11.	900	45	375	754
12.	1000	50	378	751
13.	1500	75	408	758
14.	2000	100	419	775
15.	2500	125	414	794
16.	3000	150	546	1070

Table 4 The effect of workpiece cutting speed variation to main cutting force (Machining condition: V_w=80 m/min, f=0.2 mm/rev, a = 0.5 mm, i = 0, θ = 0, and dry)

No	Tool rotation speed		Main cuuting force F_Y, N
	N, Rpm	VT, m/min	
1.	0	0	340,832
2.	100	5.0	367,820
3.	200	10	348,427
4.	300	15	364,161
5.	500	25	354,084
6.	600	30	300,202
7.	700	35	281,639
8.	800	40	284,986
9.	1000	50	290,242
10.	1500	75	283,339
11.	2000	100	272,194
12.	2500	125	226,195
13.	3000	150	232,926

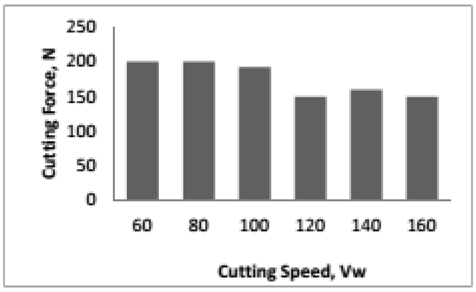
continued..

Table 5 and Fig. 4 show the result of workpiece cutting speed variation to main cutting force and chip temperature on the following machining condition: V_T=35 m/min, f=0.1 mm/rev, a = 0.5 mm, inclination angle = 0, θ = 0, and dry. At the cutting tool speed of 35 m/min, the cutting force and cutting temperature decrease with the increasing of cutting speed. The cutting force decrease from 200 N to 150 N. Decrease in cutting forces according to experiments conducted by Lei & Liu

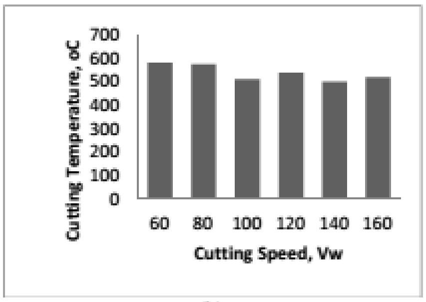
[6]Decrease in cutting forces can be understood as the effect of thermal softening and reduced friction due to the increase in cutting speed. Thermal softening causes a decrease in strength of materials, the increase in friction angle and lower large plastic deformation [7]. But in this simulation cutting temperature decreases with increase in cutting speed. This is somewhat different from the usual obtained by other researchers. However, this temperature decrease is expected when going very rotating cutting tool wear in machining. Thus using a rotating cutting tool rotating at a speed of 35 m / min can be used.

Table 5 The effect of workpiece cutting speed variation to main cutting force and chip temperature (Machining condition: V_T=35 m/min, f=0.1 mm/rev, a = 0.5 mm, i = 0, θ = 0, and dry)

No	Workpiece cutting speed Vw, m/min	Cutting force, N	Cutting temperature (*chip*), °C
1.	60	200	581
2.	80	200	575
3.	100	192	512
4.	120	150	540
5.	140	160	500
6.	160	150	520



(a)



(b)

Fig. 4 (a) Effect of cutting speed on cutting forces, (b) Effect of cutting speed on chip temperature

Conclusions

The conclusions of this work can be drawn as follows:

1. The cutting force and cutting temperature are in lowest value at the tool rotary of speed of 35 m/min.
2. The cutting force and cutting temperature will decrease with the cutting speed increasing at tool speed of 35 m/min. Hence, to lower the temperature of the machining at high speed using driven rotary tool, the recommended tool rotational speed is 35 m / min.

Acknowledgement

The authors would like to thanks to The General Directorate of Higher Education, Indonesian Ministry of Education and Culture for sponsoring this work under Contract No. 582/UN26/8/PL/2013.

References

[1] Shuting Lei and Wenjie Liu, "High-speed machining of titanium alloys using the driven rotary tool," *International Journal of Machine Tools & Manufacture*, vol. 42, pp. 653-661, 2002.

[2] Tero Stjenstoft, "Machining of some difficult-to-cut material with rotary cutting," The Royal Institut of Technology, KTH, Stockholm, Dissertation 2004.

[3] Grzegorz Wieloch et al., "New Idea in construction and performance of turning rotary knife," *Annals of Warsaw University of Life Sciences*, vol. 72, pp. 433-437, 2010.

[4] Ladislav Kandrac, Ildiko Mankova, Marek Vrabel, and Josef Beno, "Finite Element Simulation of Cutting Forces in Orthogonal Machining of Titanium Alloy Ti-6Al-4V," *Applied Mechanics and Materials*, vol. 474, pp. 192-199, 2014.

[5] Mikell P. Groover, *Fundamental of Modern Manufacturing Processes*. New Jersey: John Wiley and Sons, 2007.

[6] S. Lei and W. Liu, "High-speed machining of titanium alloys using the driven rotary tool," *Int. Journal of Machine Tool & Manufacture*, vol. 42, pp. 653-661, 2002.

[7] J.P. Davim and C. Maranhao, "A study of plastic strain and plastic strain rate in machining of steel AISI 1045 using FEM analysis," *Materials and Design*, vol. 30, pp. 160-165, 2009.