MANUFACTURING TECHNOLOGY
June 2017, Vol. 17, No. 3

Content

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Tel.: +420 475 285 534
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Print
PrintPoint Ltd, Prague

Publisher
J. E. Purkyne University in Usti n. Labem
Pasteurova 1, 400 96 Usti n. Labem
Czech Republic
VAT: CZ44555601

Published 6 p. a., 300 pcs.
published in June 2017,
140 pages

Permission: MK CR E 20470

ISSN 1213–2489

indexed on: http://www.scopus.com

MANUFACTURING TECHNOLOGY
June 2017, Vol. 17, No. 3

Content

MTAA
Manufacturing Technology
Article Administration

Web portal of Manufacturing Technology Article Administration. More information on home page of the journal.

Home page
http://journal.strojirenskatechnologie.cz/

Indexed on databases:
[SC] http://www.scopus.com
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[EI Compendex] http://www.engineeringvillage.com

The Effect of the Tool Wear on the Correlation of Forces on the Face and Flank Surfaces of the Cutting Tool

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A new comparison method of the total forces for different contact areas has been published which allows increasing determination accuracy for cutting forces on flank surface. In this regard, on the basis of the new method the laboratory of the Department of Machining and Assembly of the Technical University of Liberec has carried out a study to determine the effect of tool wear on the correlation of forces on the face and flank surfaces of the cutting tool when cutting various materials.

Keywords: Machining, Cutting force, Wear

Acknowledgments

This article is related to the investigation on the Specific University Research Projects which are supported by the Ministry of Education (MSMT) of the Czech Republic.

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Paper number: M201751

FOD Experimental Simulation and Analysis of Potential Benefits of Modified Blisk Geometry

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The article deals with testing of the resistance against Foreign Object Damage (FOD) on leading edges of blisks (blade disks) in turboprop engines made of Ti6Al4V alloy. Such damage can occur during operation, when rapidly rotating compressor parts on the engine intake are exposed to foreign particles. E.g. operation of small passenger aircrafts in desert areas, where large amounts of foreign particles occurs in the atmosphere. The paper describes the development of method for testing the resistance of the leading edge of the blades against FOD in order to mimic the conditions of operational damage. Further it quantifies potential benefits of modification in the geometry of the blisk leading edge and compares results of FOD resistance of sharp leading edge and modified geometry. Results of metallographic analysis for deformed areas near the FOD on Ti6Al4V alloy are also presented.

Keywords: FOD, Foreign Object Damage, Ti6Al4V blisk

Acknowledgement

This work was supported by the Technological Agency of Czech Republic – project number TH01011405.

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Paper number: M201752

Strength Analysis of a Structure for Attachment of a Winch on SUV

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The paper deals with design proposal of a cover part of a strength bumper, which is tasked with creating the outer design lines of an automobile without sharp edges according to legislation in force and also with protecting a vehicle against damage. The cover part serves for covering the strength part of a back strength bumper, which will be equipped with a winch and used in off-road vehicle Nissan Patrol Y61. Another aim is to perform a FEM analysis of the strength part of the bumper loaded by towing force of the winch and thus to verify a safety of the structure. The next solution of the issue will be an approach to real testing, which will verify a correctness of a numerical computations and also fulfilment of the purpose of creating the structure. Bases of FEM analysis and practical experimental verifications of the structure will be also used as a background for granting approvals, certifications and type approval by superior authorities.

Keywords: Numerical analysis, Winch, SUV, Bumper

Acknowledgement

This work was created during the project "RAILBCOT – Laboratory test bench for railway wheels tread wear analysis", ITMS code 26220220011 with the support of operational programme Science and Research financed by the European Regional Development Fund. This work was also supported by the project no. APVV-0842-11: "The simulator equivalent operating railway load on a test bench".

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Paper number: M201753

Dynamics of Linear Hydraulic Cylinder with Mass Load

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The paper deals with examination of dynamics of linear hydraulic cylinder with mass load. The hydraulic cylinder is placed in vertical position. There is experimentally simulated a system state. In this case a higher piston velocity is achieved due to the mass load compared to the piston velocity that corresponds to a supplied flow. A piston oscillation of the hydraulic cylinder is caused by rapid stop of movement in a desired position. There are experimentally evaluated eigenfrequencies of the linear hydraulic cylinder depending on the piston position and the mass load. Mineral oil was used as the working liquid. Time dependencies of pressures are measured on sides of the piston and the piston rod. Furthermore there are measured time dependencies of the piston position and the oil temperature. A mathematical model is created for this hydraulic system. This model is realized by Matlab SimHydraulics software. There are simulated time dependencies of the piston position and the pressure on the side of the piston rod. The mathematically simulated time dependencies of the pressure and the piston position are compared with the experiment.

Keywords: Eigenfrequency, Hydraulic Cylinder, Simulation, Measurement, Piston Position.

Acknowledgements

The work presented in this paper was supported by a grant SGS „Research in field of fluid systems dynamics" SP2017/103.

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Paper number: M201754

Effect of Selected Factors on the Accuracy of Load Capacity of the Schoen Gyroid Cellular Structure

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One of the roles of mechanical engineering is to improve the efficiency and performance of mechanical parts. Cellular lattice structures can be a good tool for achieving this target. This paper focuses on a specific kind of lattice structure which is composed of cells called a Schoen Gyroid. Samples containing this porous structure were subjected to a series of pressure tests. The main aim is to find the possible influence of certain factors on the accuracy of the load capacity. The selected factors are the friction between the porous sample and the testing device, then the matrix size of the samples. The discovered relationships of these factors on the accuracy were used for the final pressure test where the effect of changing strut thickness on load capacity is measured.

Keywords: Schoen Gyroid, lattice structures, Rigid Constructions, Additive Manufacturing, Selective Laser Melting

Acknowledgement

The present contribution has been prepared under project LO1502 'Development of the Regional Technological Institute' under the auspices of the National Sustainability Programme I of the Ministry of Education of the Czech Republic aimed at supporting research, experimental development and innovation.

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Paper number: M201755

Impact of Wheelset Steering and Wheel Profile Geometry to the Vehicle Behavior when Passing Curved Track

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Ride of vehicles along curved track is a serious technical problem, which for the long term requires attention of vehicle engineers as well as track designers. It is especially interesting to observe behavior of tram cars passing a curved track, because they should be able to pass arcs up to 17 meter radius. Ride of a vehicle along such strongly curved track is nowadays accompanied by significant wear in rail-wheel contact, increased bogie and track stress and by generation of noise. One of the key causes of this unfavorable phenomenon is an increase of slip velocities in rail-wheel contact. This paper is based on simulation analysis, which compares different ways of minimizing slip velocities and thus mitigating the impacts of passing vehicles on the track as well as on the car itself. Bogies with and without wheelset steer possibility were analyzed. Both bogies were also analyzed with wheel profiles of different delta R function course.

Keywords: wheelset steering mechanism, passing of vehicle trough transition curves, simulation analysis, creep velocities in wheel - rail contact.

Acknowledgement

This paper was created after the processing of the project "RAILBCOT - RAIL Vehicles Brake COmponents Test Stand", ITMS Code 26220220011 based on the support of Research and Development Operational Program financed by European Fund of a Regional Development. The work was also supported by the project No. APVV-0842-11: "Equivalent railway operation load simulator on the roller rig".

Research-Educational Center of Rail Vehicles (VVCKV)

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Paper number: M201756

Precising of Vehicles Handling Valuation

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The article describes the possibilities of vehicle passability testing by the help of computational simulation. It is used here computing simulation system ADAMS AVT. The simulations can help to find quick answers to basic and additional questions of design change influences in the area of testing vehicle passability. The first part of the article contents description of partial computation simulation models construction which the calculations are associated with. There are mentioned the binding conditions of calculations also. There are mentioned and evaluated the results of performed simulation calculations in the second part of the article. These calculations are performed in order to find out an influence of operation conditions on the vehicle passability. Real operation condition is invasive vehicle speed into a slope in this case. Under investigation are the changes of beaten distance uphill that is the vehicle able to overcome.

Keywords: simulation, computational modeling

Acknowledgement

The article arose under effective supports of Partial intention for the development of organization "VÝZBROJ" (DZRO K- 201) of Faculty of Military Technology of University of defence.

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Paper number: M201757

Some Aspects of a Manufacturing Process Simulation

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The submitted paper presents possibilities of a simulation for a real manufacturing process in a company taking the risks into consideration. The risks may result from various sources in manufacturing environment. The most significant ones include a human factor, the processes in general and environs where the manufacturing process takes place. Risk can be viewed as a state where there is a possibility of a loss but also a hope of gain since one would never jeopardize the loss if there were no chance of a win. Because of the argument that a risk is perceived differently depending on the observer's experiences and objectives, it has become increasingly important in organisations to create awareness and gain information of potential risks. The paper is aiming to present the possibilities how to avoid such risks or to decrease them to an acceptable level through simulation and modelling tools.

Keywords: Risk, Manufacturing industry, Experiments, Simulations

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Paper number: M201758

The Use of Material-Technological Modelling to Determine the Effect of Temperature and Amount of Deformation on Microstructure Evolution in a Closed-Die Forging Treated by Controlled Cooling

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From the initial feedstock to the final product, the manufacture of forged parts is a highly complex process in which a large number of technological factors play their role. These factors are associated with temperature and the amount and rate of deformation. Developing a manufacturing route often involves major effort being put into finding optimum production parameters with respect to boundary conditions which mainly comprise customer requirements and financial aspects. In order to determine an optimum set-up for forging production or to introduce a new technology, a number of essential steps must be taken and sometimes repeated. In this context, material-technological modelling is a promising and effective tool which enables numerous optimization phases to be carried out in a laboratory environment without disrupting the operation of production lines in forge shops. The present paper describes material-technological modelling of production of a closed-die forged part of microalloyed steel involving the use of controlled cooling. The objective of this investigation was to define the processing window for microstructure evolution, depending on the forging temperature, the amount of deformation, and the rate of cooling from the finishing temperature.

Keywords: material-technological modelling, 30MnVS6, forging temperature, closed-die forging, microalloyed steel

Acknowledgement

The present contribution has been prepared under project LO1502 'Development of the Regional Technological Institute' under the auspices of the National Sustainability Programme I of the Ministry of Education of the Czech Republic aimed to support research, experimental development and innovation.

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Paper number: M201759

The Effect of Surface Pre-Treatment and PVD Coating Post-Treatment on Texture of Surface ASP2052®/Tin

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The aim of the paper is analyse changes of the surface texture during pre-treatment, PVD coating and post-treatment. Generally, the effect of the production technology is often discussed with well-known parameters such as material, geometry of tools, coating methods and conditions. Effect treatment of the substrate or tools manufacturing are mostly ignored. Pre-treatment, coating and post-treatment obviously change surface texture. Quality of surface or surface texture together with properties of the surface layer have a significant effect of lifetime and reliability of operation component in practice. Surface texture effect running accuracy components, noise and running in period, friction loss, heat transfer, fatigue strength, resistance against wear and corrosion. The experiment was performed on ASP2052® tool steels during coating by PVD (Physical Vapour Deposition). The surface of the substrate was wet and dry sandblasted. Treated surface of experimental samples were coating of TiN. After coating surface of the samples was polished by and wet sandblasted to achieve glossy finished. The results of the paper show effect various type of the treatment on surface texture before and after PVD coating. Measurement of the surface texture shows progression of the parameters surface textures.

Keywords: Polishing, Sandblasting, Quality of surface, Measurement of surface texture.

Acknowledgement

The paper was prepared with the support of the Project for the Development of the Organization and by the Specific research project 2017 of the Department of Mechanical Engineering, UoD "Promoting Research, Science and Innovation in the Field of Engineering".

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Paper number: M201760

The Effect of the Shape of Chip Cross Section on Cutting Force and Roughness when Increasing Feed in Face Milling

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In this paper, the results of an investigation done with face milling are presented. The changes in cutting force and surface roughness were studied through changing the values of depth of cut and the feed per tooth. Meanwhile the permanent value of the undeformed chip cross section, which was determined (f_z and a_p), remained permanent. Increasing f_z and keeping the same value of A_c chip cross section, the ratio a_p/f_z changed in five grades from 0.5 to 8. It is shown, that if the feed is increased in the examined range so that the chip cross section is constant, then the value of the cutting force decreases, which decrease can be observed in all three force components. Accordingly, the mechanical power required for cutting is reduced. The results of the surface roughness investigations showed that initially a significant increase can be observed in the roughness with the gradual increase of the feed (up to $a_p/f_z = 2.5$), followed by a moderate increase afterwards.

Keywords: Equation face milling, permanent chip cross section, cutting force, surface roughness

Acknowledgments

The authors greatly appreciate the support of the Hungarian National Research, Development and Innovation Office – NKFIH (Agreement No. OTKA K 116876).

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Paper number: M201761

The Use of Simulation Programmes for the Structural Analysis and Engineering Optimization of Gating System Structures for Use with High Pressure Die Casting Technology

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A properly designed and engineered gating system for use with high pressure die casting technology will produce castings with excellent mechanical properties. The gating system must secure the fast and continuous filling of the cavity. An appropriately designed and structured gating system can reduce the length of the die casting process, thereby increasing the effectiveness of production, reducing the amount of waste, and delivering cost savings. This article focuses on the structural analysis and optimization of runners and their impact on the mould casting of a specific light-weight casting made of AlSi alloy.

Keywords: die casting, simulation analysis and modelling, optimalization

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Paper number: M201762

The Influence of the Technological Parameters of Rolling in the Helical Rollers and Longitudinal Wedge Mill on the Quality of Two-Phase Titanium Alloy

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This article presents a new technology of obtaining the flat products with an ultrafine structure. The ultrafine-grained structure is obtained by using severe plastic deformation which is developed by the helical rollers. The stress-strain state (SSS) of the workpiece during rolling process in the helical rollers and longitudinal wedge mill is investigated in this scientific paper. The quantitative data has been obtained by the finite element method and MSC.SuperForge software; as well as the basic SSS distribution patterns, the temperature in simulating the rolling in the helical rollers and longitudinal wedge mill with different number of passes and the single reduction have been established. The rational technology of rolling the two-phase titanium alloys was developed and tested in the laboratory. The special attention is paid to analysis of the influence of the rolling conditions in the helical rollers and longitudinal wedge mill on the formation of VT6 titanium alloy microstructure.

Keywords: the titanium alloys, the rolling, the stress-strain state, a numerical simulation, a single reduction.

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Paper number: M201763

Generating Random Pattern for Homogenization of Fiber Reinforced Composites Using Memetic Algorithm

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The paper presents solution to random generation of fibers in composite materials for homogenization using representative volume. Randomly positioned fibers with random diameters of constrained sizes are generated within predefined representative volume, while minimal gap between fibers and volume ratio of fibers in the matrix is maintained. The problem of random generation is solved as an optimization problem using a custom memetic algorithm designed by the authors. A comparative study was performed, comparing performance of memetic algorithm and genetic algorithm.

Keywords: homogenization, composite, fibers

Acknowledgement

This work was supported by the Slovak Grant Agency VEGA 1/0795/16.

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Paper number: M201764

The Corrosion Resistance of Turbocharger Stator after Plasma Nitriding Process

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The plasma nitriding technology was applied on the turbocharger stator wheel. Martensitic stainless steel X12Cr13 was choosen for the experiment. The influence of plasma nitriding process on the corrosion resistance of selected steel was investigated. The chemical composition of selected steel was verified using the Q4 TASMAN device. After plasma cleaning procedure was plasma nitriding process performed using two stage nitriding procedure. The microstructure and mechanical properties of the nitride layers were studied using optical and laser confocal microscopy and hardness testing. The depths of plasma nitride layers were also estimated using cross-sectional microhardness profiles measuring. The corrosion resistance of plasma nitrided X12Cr13 steel samples were evaluated in a 5 % neutral sodium chloride solution (NSS) in accordance with ISO 9227 standard in the VLM GmbH SAL 400-FL corrosion chamber and visually verified. Microhardness and surface hardness of experimental samples were significantly increased, but the corrosion resistance significantly decreased.

Keywords: plasma nitriding, stainless steel, nitride layer, corrosion resistance

Acknowledgements

The paper has been prepared thanks to the support of the project "The Development of Technologies, Design of Firearms, Ammunition, Instrumentation, Engineering of Materials and Military Infrastructure VÝZBROJ (DZRO K201)." and "Surface technology in applications special techniques SV16-216."

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Paper number: M201765

Effect of Hydraulic Oil Entering the Cutting Fluid on the Tool Life and Roughness in Milling of Stainless Steel

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The use of cutting fluid increases the tool life and reduces the roughness of the machined surface. However, during the machining the oil from the hydraulic system of the machine often gets into the cutting fluid, which can alter the properties of the cutting fluid. In scientific literature there is no information on the effect of the hydraulic oil entering the cutting fluid on the tool life and roughness. In this regard, at the laboratory of the Department of Machining and Assembly of the Technical University of Liberec, there has been conducted a study to ascertain the effects of hydraulic oil getting into different types of cutting fluids during the milling of stainless steel.

Keywords: Machining, Cutting fluid, Wear

Acknowledgments

This article is related to the investigation on the Specific University Research Projects which are supported by the Ministry of Education (MSMT) of the Czech Republic.

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Paper number: M201766

Application of Brakes on Cranes in River Ports

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In the last decades, advanced brake technology in the port sector follows the global productivity developments of the international maritime trade. Container vessels are getting bigger and bigger and the ship to shore cranes is getting consistently higher. But service, emergency or storm brakes cannot be getting bigger and bigger to meet these increasing demands. Throughout history, innovations and advancements in technology have made industry better through automation and increased efficiency. No matter how advanced industry becomes, the need for emergency duty stopping brakes will not go out of style because there are always circumstances that require mechanical brakes to do the job. Brakes will invariably insure against those rare, yet potentially catastrophic events that even modern technology cannot defend against.

Keywords: brakes, disc, regulated braking, emergency brake, braking torque.

Acknowledgement

This publication was created in the frame of the project Research of a technological base for draft of application of renewable sources of energy in practice, ITMS code 26220220083, of the Operational Program Research and Development funded from the European Fundof Regional Development.

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Paper number: M201767

Production of Planetary Mechanism Model Prototype using Additive Method of Rapid Prototyping

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An article deals with a production of a planetary mechanism model prototype using an additive method of Rapid Prototyping (RP) by a 3D printer called uPrint. The first part of the article contains a theoretical analysis of a main principle and kinematics parameters of the planetary mechanism model. The second part begins with an experimental analysis of a planetary assembly calculation and continues with a description of a production process of all individual mechanism parts and description of the final completing of the planetary mechanism prototype. The final part deals with a characterization of ABS styrene polymers generally used for production printed by uPrint device.

Keywords: Additive Method, Rapid Prototyping, Fused Deposition Modelling, uPrint, Planetary Mechanism, ABS Styrene Polymer

Acknowledgement

This article was supported and co-financed from a specific research FSI-S-16-3717 called "Research in Field of Modern Production Technologies for Specific Applications".

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Paper number: M201768

Freight Bogie Prototype Properties Analysis by Means of Simulation Computations

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The object of this article is to analyse the stability of changed three axle rail bogie structure, which is characterized below by higher axle loads combined with good operational properties. The occasion of change was the unstable behaviour of the system during prototype development. For validation of the structure design, there has been created a substitute simulation model in program Simpack, by which the computations were performed for partial system. Model represents only elasto-kinematic properties of the system. For stability analysis of the system, there have been a set of boundary conditions from different degrees of freedom to state out of balance. Simulation calculations show, that up to one oscillation in the y-direction, which is damped in real bogie by friction in suspension and dampers Lenoir, is the system after all deflections in initial condition. Substantial unstable behaviour does not show already.

Keywords: Stability Analysis, Bogie Prototype, Balance Beams, Simulation Computations.

Acknowledgement

This paper was created in accordance to the processing of the project "RAILBCOT - RAIL Vehicles Brake COmponents Test Stand", ITMS Code 26220220011 based on the support of Research and Development Operational Program co-financed from EU sources. The work was also supported by the project No. APVV-0842-11: "Equivalent railway operation load simulator on the roller rig".

Research-Educational Centre of Rail Vehicles (VVCKV)

This paper was created in accordance to the processing of the project "Development of two types of freight wagons with bogies for non-standard wheelbase or track wheelset, complying with the criteria for interoperability, Environmental Issues, safety and reliability ", ITMS Code 26220220070 based on the support of Research and Development Operational Program co-financed from EU sources.

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Paper number: M201769

Application of FE Modelling of Machining Using DEFORM™

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DEFORM™ is a robust modelling software tool which uses the finite element method (FEM) for modelling technologies in 2D and, naturally, in 3D. One of the processes, the modelling of which DEFORM™ supports, is slab milling.
For this purpose it uses an advanced FE model with various parameters, such as the fracture criterion. If their values are not chosen correctly, the desired results cannot be obtained.
A 3D simulation model was developed to explore the capabilities for entering data, calculating and evaluating temperature distribution within a workpiece during experimental milling carried out under real-world cutting conditions. The FEM model concerns the temperature on the rake face of an exchangeable cutting insert. The primary aspect which was monitored was the temperature field during chip formation.
Finally, the results of the simulation were compared with data from a machining experiment. The material used for the simulation and for the machining experiment was the ČSN 12050.1 / AISI 1045 steel.

Keywords: slab milling, computer simulation, FEM, DEFORM™, experiments

Acknowledgement

The present contribution has been prepared under project LO1502 'Development of the Regional Technological Institute' under the auspices of the National Sustainability Programme I of the Ministry of Education of the Czech Republic aimed to support research, experimental development and innovation.

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Paper number: M201770

Taylor Equation of Durability and Its Modification

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Recent development of the application of new kinds of material in transport and production technology places higher requirements on the technologist at the determination of cutting conditions. The assortment of recent kinds of cutting material enables to intensify cutting conditions while maintaining acceptable tool durability. The dependence of tool durability on cutting speed, or „basic law of machining", is the basic means to determine tool durability at selected cutting conditions. The paper contains a suggestion to modify the original Taylor equation on recent conditions of productive machining.

Keywords: Machining, tool life, tool wear, sintered carbide

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Paper number: M201771

Kinematic and Dynamic Analysis and Distribution of Stress in Items of Planar Mechanisms by Means of the MSC ADAMS Software

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This paper presents a kinematic and dynamic analysis and distribution of the stress in items of a planar mechanism by means of the MSC ADAMS software. Graphic dependence of kinematic and dynamic magnitudes of some points is given in dependence on the angle of rotation of the driving item and in dependence on the time. Distribution of the stress in the items presented is in [Pa]. In relation to the kinematic and dynamic analysis and subsequent simulation [1-3] of the planar as well as spatial mechanisms, it is great solution to use MSC Adams software program. The considerable advantage of this mentioned program is based on its simplicity from the aspect of modelling and moreover, it is important to point out that utilisation of the mentioned program leads to results which are precise and accurate in the case of the numerical solution of the equations in the whole magnitude referring to motion of mechanism while the given results are obtained in the graphic form.

Keywords: kinematic analysis, dynamic analysis, finite element method, planar mechanism

Acknowledgement

This work was supported by the Slovak Grant Agency VEGA 1/0649/17, KEGA 007TnUAD-4/2017, and resulted from the project "Center for quality testing and diagnostics of materials", ITMS code 26210120046 relating to the Operational Program Research and Development funded from European Fund of Regional Development.

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Paper number: M201772

Use of Technical Diagnostics Means in Industrial Practice

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Use of means of technical diagnostics gains in today's period increasing importance in all areas of industrial activity. Due to the tightening of the limits, software and hardware solutions improving is the diagnosis of the building one of the most important area in manufacturing and non-manufacturing organizations. The aim of the article is to clarify the possibility of using diagnostic procedures in the form of georadar to monitoring of location and status of reinforcement in a ferroconcrete bearing wall. For measuring was used radar system Mala CX12 with accessoriesand based on selected aspects has been diagnosed the exact location and status of the construction reinforcement. The result of this monitoring is to detect variations in the position of reinforcement and recorded corrosive damage. We investigated the humidity of concrete wall through the diffusion of EM waves while the evident product of decrease of the diffusion speed was the increased moisture of structure.The main outcome is to propose corrective measures in the form of the concrete carrying wall remediation necessity, as indicated by the results of this monitoring. By early use of the diagnostic means in the form of monitoring using georadar, it is possible to prevent the economic and environmental impacts.

Keywords: diagnostics, georadar, model, monitoring

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Paper number: M201773

Research on Mechanical and Electrical Properties of Carbon Nanotubes Reinforced Cement-based Materials

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In this paper, the effects of carbon nanotubes on the mechanical and electrical properties of cement-based composites at different ages have been studied. The structures were characterized by SEM. The experimental results show that the higher content of carbon nanotubes may enhance the strength, when the content of carbon nanotubes is 0.1%, the 3d flexural strength increases about 60.6%, 28d strength increases about 57.4%, the 3d compressive strength increases about 33%, 28d strength increases about 11.6%. Highly dispersed carbon nanotubes can form uniform network structure in cement paste, so the mechanical properties of composites can be greatly improved. The conductivity of specimen increase with the content of carbon nanotube increasing, but decline as the content is more than 0.1%, the rate of decline is slow. Carbon nanotube is conductive, they superpose each other and form the conductive network, which can make the cement based material capable of conducting. SEM pictures show that dispersion of the carbon nanotubes in the cement matrix is difficult when the content is more than 0.2%.

Keywords: Mechanical properties, Electrical properties, Carbon nanotube

Acknowledgements

The writers are grateful for support provided through the Natural Science Foundation of Hebei Province of China (E2015210083).

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Paper number: M201774

A Mechanistic Model for Prediction of Cutting Parameters in Micro-Scale Milling

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While down-scaling of micro milling process is similar to the conventional process, there are specific issues that differ from macro machining due to higher ratios of feed per tooth to tool radius and tool run-out to tool diameter, size-effect, minimum chip thickness, elastic-plastic deformation, microstructure effects, etc. One of the challenges in micro machining is attaining accurate and reliable machining parameters, which can reduce tool wear and breakage to achieve higher productivity and quality at a lower cost. Therefore, this paper presents a new mechanistic model for predicting the precise process parameters considering material properties and principles of micro-milling under various cutting conditions. The proposed model also takes into account the nonlinearity and dynamics of minimum chip-thickness, micro-milling cutting forces considering cutting, as well as edge and damping coefficients into. The predicted stability lobes and the stability limits from experiments are in sufficient agreement. The research of micro-scale milling parameters is significant to improve the precision of machined parts, reduce the wear and tear of the micro-milling blade and extend the life of micro-tools.

Keywords: Micro chatter, Lobe diagram, Spindle speed, Axial cutting depth, Damping effect.

Acknowledgement

This research is supported by the Foundation for Outstanding Young Scientist in Shandong Province (Grant No. BS2014ZZ007), China Postdoctoral Science Foundation Funded Project (Grant No. 2016M5922165),Qingdao Post-doctoral Applied Research Project(Grant No.2015182) and The Scientific Research Foundation of the SDUST (Grant No. 2014RCJJ023).

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Paper number: M201775