

**ABSTRACTS****Jan Słota, Ivan Gajdos, Emil Spišák, Marek Šiser***Springback Prediction of Stretching Process using Finite Element Analysis for DP600 Steel Sheet*

Springback phenomenon is well predicted for some mild steel materials, but not for steels with higher strength. One of the most used tools to stamping optimization is usage of finite element analysis. In order to accurately describe the real behaviour of the materials for stamping of vehicle panels, the application of proper hardening rule seems to be crucial. Due to higher accuracy of predicted results, high strength steel sheets are usually modelled by means of kinematic or mixed isotropic-kinematic hardening models. In this paper the springback prediction of advanced high strength steel DP600 by numerical simulation was investigated. Through cyclic tension-compression tests, the material characterization has been performed for DP600 steel sheet. Different hardening models (isotropic, kinematic and mixed isotropic-kinematic) used in the simulations were compared with experiment. The Yoshida-Uemori model successfully describes the kinematic behaviour of the material and provided more accurate results than others.

**Tadeusz Pała, Ihor Dzioba, Jarosław Gałkiewicz***Verification of Strength of the Welded Joints by using of the Aramis Video System*

In the paper are presented the results of strength analysis for the two types of the welded joints made according to conventional and laser technologies of high-strength steel S960QC. The hardness distributions, tensile properties and fracture toughness were determined for the weld material and heat affect zone material for both types of the welded joints. Tests results shown on advantage the laser welded joints in comparison to the conventional ones. Tensile properties and fracture toughness in all areas of the laser joints have a higher level than in the conventional one. The heat affect zone of the conventional welded joints is a weakness area, where the tensile properties are lower in comparison to the base material. Verification of the tensile tests, which carried out by using the Aramis video system, confirmed this assumption. The highest level of strains was observed in HAZ material and the destruction process occurred also in HAZ of the conventional welded joint.

**Ryszard Sygulski, Michał Guminiak, Łukasz Polus***Stability of a Steel Welded Girder with Bending and Shear Forces Included*

The stability of the element of a steel welded girder subjected to bending and shear forces is considered. The considered element is a rectangular plate supported on boundary. The type of a plate boundary conditions depend on the types (thickness) of the stiffeners. Considered plate is loaded by in-plane forces causing bending and shear effects. The Finite Element Method was applied to carry out the analysis. Additionally the Boundary Element Method in terms of boundary-domain integral equation was applied to evaluate the critical shear loading.

**Najeeb Alam Khan, Shahnaila Aziz, Saif Ullah***Entropy Generation on MHD Flow of Powell-Eyring Fluid Between Radially Stretching Rotating Disk with Diffusion-Thermo and Thermo-Diffusion Effects*

An investigation is performed for analyzing the effect of entropy generation on the steady, laminar, axisymmetric flow of an incompressible Powell-Eyring fluid. The flow is considered in the presence of vertically applied magnetic field between radially stretching rotating disks. The Energy and concentration equation is taken into account to investigate the heat dissipation, Soret, Dufour and Joule heating effects. To describe the considered flow non-dimensionalized equations, an exact similarity function is used to reduce a set of the partial differential equation into a system of non-linear coupled ordinary differential equation with the associated boundary conditions. Using homotopy analysis method (HAM), an analytic solution for velocity, temperature and concentration profiles are obtained over the entire range of the imperative parameters. The velocity components, concentration and temperature field are used to determine the entropy generation. Plots illustrate important results on the effect of physical flow parameters. Results obtained by means of HAM are then compared with the results obtained by using optimized homotopy analysis method (OHAM). They are in very good agreement.

**Maciej Słowik, Daniel Ołdziej, Zdzisław Gosiewski***Integration and In-Field Gains Selection of Flight and Navigation Controller for Remotely Piloted Aircraft System*

In the paper the implementation process of commercial flight and navigational controller in own aircraft is shown. The process of autopilot integration were performed for the fixed-wing type of unmanned aerial vehicle designed in high-wing and pull configuration of the drive. The above equipment were integrated and proper software control algorithms were chosen. The correctness of chosen hardware and software solution were verified in ground tests and experimental flights. The PID controllers for longitude and latitude controller channels were selected. The proper deflections of control surfaces and stabilization of roll, pitch and yaw angles were tested. In the next stage operation of telecommunication link and flight stabilization were verified. In the last part of investigations the preliminary control gains and configuration parameters for roll angle control loop were chosen. This enables better behavior of UAV during turns. Also it affected other modes of flight such as loiter (circle around designated point) and auto mode where the plane executed a pre-programmed mission.

**Czesław Janusz Jermak***Discussion on Flow-Through Phenomena in the Air Gauge Cascade*

In the paper, the flow-through phenomena in the air gauge are under discussion from the thermodynamic and gasodynamic perspective. The main elements of the cascade are considered the inlet nozzle (restriction), measuring chamber and the measuring nozzle with the measuring slot (displacement between the nozzle head and measured surface). The purpose of the analysis was to point out the impact on the metrological characteristics of the air gauge. In particular, attention was paid to the airflow through the measuring slot. Here, the complex phenomena take place, among others the supersonic areas and a "bubble ring," which cause discontinuity and hysteresis in the static characteristic. On the other hand, the air stream expansion after the restriction (inlet nozzle) is observed in the measuring chamber. The point of the above discussion was to work out some recommendation on the nozzles geometry and the localization of the back-pressure measuring point in the chamber.

**Paweł Sidun, Andrzej Łukaszewicz***Verification of Ram-Press Pipe Bending Processes using Elasto-Plastic FEM Model*

In this paper selected aspects of numerical modelling of bending pipes process are described. Elasto-plastic material model was used in COMSOL FEM environment. The results of numerical analyses of two kinds of steel were presented. The correctness of the proposed model was verified based on comparison shapes of deformed pipe profile obtained at the ending step of bending both from numerical simulations and experiment.

**Dariusz Urban, Marek Jałbrzykowski, Maria Gołębowska***Fatigue Testing of Dental Bridges on Selected Examples*

The paper presents example tests of the functional quality of selected designs of dental bridges. These were: porcelain bridges on a metal base (cobalt based alloy), porcelain bridges on a zirconia base (zirconia ceramic – Zirkon Zahn), and full zirconia bridges (Zirkon Zahn). For the purpose of the study, durability of bridges in cyclic fatigue testing was adopted as a measure of their quality. The tests were carried out on a Zwick Roell Z010 universal testing machine. They consisted in cyclic loading and unloading of dental bridges mounted on gypsum models at a loading force of  $F = 400$  [N] and a frequency of load of  $f = 1$  [Hz]. Each bridge was subjected to a cycle of 7200 loads. The results show that there are no significant differences in the functional quality of the bridges.

**Volodymyr Kalchenko, Andriy Yeroshenko, Sergiy Boyko, Nataliia Sira***Determination Of Cutting Forces In Grinding With Crossed Axes Of Tool And Workpiece*

In the work the analysis of existent methods of determination of local and general forces of cutting at polishing of surfaces with a type as the arc of circumference is given. The dependence for determination of speed polishing and method for determination of thickness of the cut away layer on condition of equality of the tricked into and taken off volumes of material are offered. The method of determination of cutting forces, which takes into account cutting and deforming grain, is suggested. The method of determining the thickness of a cutting layer of one of the cutting edge, from the condition that the volume of material that is brought and is cut in each local point of contact spots has been proposed. The proposed method takes into account the compliance of the processing system and the discontinuity of the abrasive surface of the tool. By experimental way upper limits of thickness cutting layer when using different abrasive materials for a wide range of cutting speeds have been obtained.

**Wojciech Horak, Bogdan Sapiński, Marcin Szczęch***Analysis of Force in MR Fluids during Oscillatory Compression Squeeze*

This study investigates the behaviour of MR fluids in the oscillatory compression squeeze mode. Experiments were performed on commercially available MR fluids in the purpose-built experimental set-up. The influence of MR fluid's properties and magnetic flux density on the force generated during the squeeze mode was investigated.

**Peter Kaššay, Jaroslav Homišin, Matej Urbanský, Robert Grega***Transient Torsional Analysis of a Belt Conveyor Drive with Pneumatic Flexible Shaft Coupling*

Development and application of pneumatic flexible shaft couplings have been in the center of our department research activities for a long time. These couplings are able to change torsional stiffness by changing pressure in their flexible elements – air bel-lows. Until now we have dealt with the use of pneumatic flexible shaft couplings for tuning mechanical systems working with periodically alternating load torque at steady state. Some mechanical systems, however, operate with a static load torque at constant speed (e.g. hoists, elevators, etc.), where it is necessary to consider the suitability of shaft coupling in terms of load torque at transient conditions (run-up and braking). Therefore we decided to analyze the use of pneumatic flexible shaft couplings also in this type of mechanical systems on an example of conveyor belt drive.

**Adam Łapiński, Dariusz Butrymowicz, Mirosława Kołodziejczyk***Measurement Approach of Mean Heat Transfer Coefficient for Packed Bed of Vegetables*

The non-invasive measurement approach of the mean heat transfer coefficient for the packed bed of vegetables may be thought as still open issue. There is a clear need for the assessment of heat transfer conditions for various types of fruits and vegetables in order to accurately predict the thermal load that is necessary to select refrigeration equipment for cold storage chamber. Additionally, there is significant development in numerical modelling of heat and mass transfer processes in cold storage chambers for fruits and vegetables which requires precise heat transfer prediction. The theoretical basis for the indirect measurement approach of mean heat transfer coefficient for the packed bed of vegetables that is based on single blow technique is presented and discussed in the paper. The approach based on the modified model of Liang and Yang was presented and discussed. The testing stand consisted of a dedicated experimental tunnel along with auxiliary equipment and measurement system are presented. The geometry of the tested vegetables bed were presented. Selected experimental results of heat transfer are presented and discussed for the packed bed of carrots. These results were presented as dimensionless relationship. The obtained results were compared with the existing dimensionless relationships developed for the packed bed consisting of elements of various regular shapes.