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Experimental Research of Dry Friction in "Alumina Ceramics – Quartz Glass" Pair

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Results of an experimental research of friction coefficient in "alumina ceramics – quartz glass" friction pair are presented. The research with pin on disc test configuration using SRV–III test machine was carried out at loads from 10 to 1000 N, constant sliding velocities 5 mm/s; ambient temperature 23°C and relative humidity 30%. The obtained results reveal that in general, friction coefficient for "alumina ceramics – quartz glass" pair decreases with the increase in normal load. It is shown that the obtained friction coefficients values at the normal force from 100 to 1000 N for the given experimental conditions can be used to pre-estimate the interference fits in "alumina ceramics – quartz glass" friction pairs.

Keywords: Friction coefficient, Friction force, Alumina ceramics, Quartz glass, Normal load.

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Tensile Properties of a Hot Stretch Formed Ti-6Al-4V Alloy Component for Aerospace Applications

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Comprehensively considering the analysis results of the microstructure, hardness and tensile properties, different zones of a component for aircraft applications manufactured through hot stretch forming were studied. The differential thermomechanical story of each studied zone of the forging was taken into account. The results reveal that the different zones strain hardened in function of the degree of the strain and strain rate experienced during the forming, with the zones most stressed at the higher strain rate showing the best tensile properties and a loss of ductility. This phenomenon is not coupled with a visible change into the microstructure morphology of the processed material.

Keywords: Hot stretch Forming, Titanium Alloys, Ti-6Al-4V, Tensile Properties, Strain Hardening

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Side Plate Strength Analysis of the Mechanism for Vehicle Axle Scale Calibration

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This paper deals with the description of a mechanism for calibration vehicle axle scales with a loading capacity up to 10 tons and strength analysis of its selected part. The strength analysis will be carried out in ADINA software and this analysis results will be used to check the safety of the structure and in case of exceeding the permissible stress, deformation, etc. This analysis results will form a benchmark material for optimisation of this structure. The next step of this issue will be strength analyses of all important parts, i.e. boxes with weights and upper girder. After performing these calculations and the resulting optimisation, the prototype production will be feasible.

Keywords: Test device, Strenght analysis, ADINA software, Vehicle axle scale

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Dynamical Analysis of a Cable Manipulator Using Multibody Approaches

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This paper deals with the creation of a computational model of a particular cable manipulator composed of a rigid manipulator with three degrees of freedom and a platform driven by four fibers. Each fiber is led over a pulley and is driven by a linear motor, which can be controlled. The multibody dynamics approach is a suitable way in order to create the manipulator model. The most common cable modelling techniques are summarized in this paper and then the computational model of the cable manipulator QuadroSphere is created using MSC.Adams software. The computational model verification is done using the modal analysis of linearized model and the experimental modal analysis on the real set up. Further results of various numerical simulations are presented and their utilization is discussed.

Keywords: Cable Manipulator, Multibody Dynamics, Cable Modelling, QuadroSphere

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Heat Loading of Steam Boilers Heating Surfaces

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This paper deals with the comparison of an analytical solution of the temperature field of a steam boiler pipe membrane wall using a numerical method calculation in the COSMOS/M programme. The result analysis showed that analytical calculating methods which are limited to 1D and 2D task types can be used for the approximate calculation of temperature in the selected locations of the membrane wall. With these methods it is not possible to obtain a complex view of the heat loading of the entire membrane wall or of the stress conditions caused by the thermal and pressure effect of steam-water mixture in the wall pipes. The results of numerical simulations have provided a complex image about the temperature and pressure distribution in the entire membrane wall of a steam boiler taking into account the material properties.

Keywords: Boiler, Membrane wall, Heat flux

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The Influence of Carbon and Silicon Content in Ductile Iron on Shrinkage Creation for Castings with Different Wall Thickness

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In modern times there are increasing requirements for quality of products in every part of manufacturing industry. In foundry industry it is not different and from the point of view of quality the most dangerous are hiden casting defects, such as shrinkage cavities. That is why a lot of foundries are researching, how to increase the efficiency of producing castings. This experimental work is dealing with search of the influence of carbon and silicon content in ductile iron on shrinkage creation. In the experimental part there is introduced the production process of test castings and results of ultrasound non destructive method. The object of this paper was to determine the influence of two main alloying elements of ductile cast iron on shrinkage creation with preserving specific strength of mould, which also has an impact on shrinkage creation.

Keywords: Ductile iron, chemical composition, shrinkage, ultrasound.

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Friction and Wear Behaviour of 42CrMo4 Steel Treated by Tenifer, Hard Chrome and Plasma Nitriding Technologies

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Concerning with effort to replace hard chrome plating cause of its ecological issues, this paper investigates the effects of surface technologies to wear resistance of ISO 42CrMo4 steel, which is popularly used in weapon production. After quenching and tempering, the experimental samples were treated by nitrocarburizing (tenifer), hard chrome plating and plasma nitriding technologies. Plasma nitriding was carried out with different gas mixture at 500ºC (plasma nitriding process) for 15h. The wear test based on principle "pin on disc" was performed to evaluate the coefficient of friction and the wear rate. The results were supplemented with surface hardness test and metallografical evaluation. The experiment results point out that nitrocarburizing and plasma nitriding improve wear resistance better than hard chrome plating.

Keywords: nitrocarburizing, hard chrome plating, plasma nitriding, pin on disc, wear resistance

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On Nonlinear Vibration and Fretting Wear of Nuclear Fuel Rods Influenced by Coolant Cross-flow

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The paper deals with mathematical modelling of nuclear fuel rod (FR) vibration in TVSA-T fuel assembly induced by pressure pulsations of coolant. The FR is modelled as a system consisting of two subsystems – fuel rod cladding and fuel pellets stack – that can possibly impact-interact. Besides, the cladding subsystem can possibly loose contact with spacer grid cells that is another source of strong mechanical nonlinearities. The contact forces in all the contact points are represented by the force-velocity-displacement characteristics that include both normal and friction forces. The influence of coolant cross-flow is analysed using partitioned approach to fluid-structure interaction description. The qualitative change of FRs motion and the change of fretting wear of the FR cladding are shown.

Keywords: Fuel Rods, Vibration, Fretting Wear, Coolant Cross-flow

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Slipping and Skidding Occurrence Probability Decreasing by Means of the Friction Controlling in the Wheel-Braking Pad and Wheel-Rail Contacts

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The paper considers the question of slipping and skidding occurrence probability decreasing by means of the friction controlling in the wheel-braking pad and wheel-rail contacts. One of the methods of stabilization of the friction in the pairs is a temperature control system based on the use of constructive and technological elements for the absorption and removal of heat from the friction pairs to the environment. The variants of technical solutions on multifunctional (temperature, abrasive) controlling tribocontacts by energy of air, air-abrasive stream or pellets of dry ice, electrically charged sand supply are proposed. Achieving optimum amount of supplied sand to the wheel-rail tribocontact is proposed through its charging using tribostatic or electrostatic methods. Presented the results of experimental research on the "Friction Machines" are the dependencies of the friction coefficient on the temperature.

Keywords: "Wheel-Braking Pad-Rail" System, Friction Machine, Temperature, Friction Coefficient

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Proposal of a Mechanism for Setting Bogie Wheelsets to Radial Position while Riding Along Track Curve

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Passing of vehicles along curved track is a serious technical problem, which needs special attention. It is especially actual in the environment of urban lines, where it is necessary to pass a track of small radius. There is a significant strain of track as well as tram´s bogies. It results in excessive wear in rail-wheel contact. Considerable is also the noise caused by operation on such track. Behavior of the vehicle when riding along track curve is influenced by the wheelset guidance design. If the wheelset guidance is able to set the wheelsets in track curve to a radial position, mitigation of the negative phenomenon can be expected. This paper deals with a design of a mechanism for setting wheelsets in a track curve to a radial position for tram cars. Dynamical analysis of a simplified tram car model was performed. Courses of monitored values of bogie with and without designed mechanism are compared.

Keywords: wheelset steering mechanism, simulation analysis, creep velocities in wheel – rail contact.

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Productivity Improvement of Assembly Lines by Lean Methods

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In a competitive market the manufacturing companies have to produce cost effective products which can be realized by minimized production cost and higher effectiveness. The application of Lean manufacturing philosophy in order to optimize costs and quality is gaining a competitive advantage. There are lots of Lean tools which can result the improvement of the production line performance.
The article is original and unique, because beside the description of theoretical background relating to the process improvement, a practical method is also introduced in a case study.
In the study the author describes the main general steps of a Lean project completed in an industrial environment. The described case study which is a part of a real R+D project shows how can be improved the efficiency and reduced manufacturing cost of a real manufacturing system by application of several Lean tools which are One-piece flow, Takt–time analysis, Line balance and Cellular design.

Keywords: Lean production, efficiency improvement, takt-time analysis, cellular manufacturing

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Digitization of Structured Composite Plates with Regard to Their Numerical Simulations

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A method of 3D scanning and a subsequent data reconstruction presented in this paper are focused on digitization of highly structured composite parts with regard to creation of a fully functional CAD and FEM model. The digitized parts are structured carbon composites made replication of steel templates. Production of steel templates is a technological procedure mostly based on pressing or rolling. However, the data obtained from 3D scanner are not in appropriate format, there are a cloud of points interleaved by a sufrace and it is necessary to use some aditional methods to solidify the resulting geometry. Most often with using commercial software as for example: Creo, Catia, Inventor, Rhino or Geomagic studio is the cloud of points parameterized in a continuous surface. Now, based on some next operations (intersections, blends) the desired solidified model in CAD format could be achieved. Despite the relatively rapid creation of the main shape the minor inaccuracies that occur during non-contact measurement results either in local areas or individual points with a large deflection. The aim of this thesis was to assess the appropriate method for creating geometry and compensation the inaccuracies with regards to numerical simulations, especially the meshing and convergency of a solved model. As has been quite surprisingly found, some local small step changes in the geometry could be for the calculation easier to solve than a complicated and highly approximated area. An influence to a solution does not seem important.

Keywords: Composite plates, 3D scan, Reverse engineering, Free surfaces, Mesh

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Theoretical Analysis of the Contact Area between Grinding Wheel Surface and Workpiece in Flat Face Grinding with Spindle Axis Inclination

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Theoretical analysis has been carried out for the determination of the analytical dependences connecting various parameters of contact area between wheel cutting surface and workpiece, such as length, width and arc length in the case of flat face grinding with preliminary inclination of spindle axis. The role of factors, such as angle of preliminary inclination of the spindle axis, grinding depth and grinding wheel diameter, in this process, are established. The capability to define the above mentioned parameters permits the calculation of the contact area between wheel cutting surface and workpiece. In addition, with the proposed methodology, it is possible to correctly determine the value of cross-feed, in the case of multiple-pass processing scheme, which, as it is known, should be consistent with the value of contact width of wheel cutting surface with workpiece. It can be guaranteed that on the ground surface there will be no areas unaffected by the wheel. In the case of through-feed grinding the obtained theoretical dependences make it possible to determine the processing conditions, taking into account the allowable value of flatness deviation. Finally, the latter, contributes in improving flat face grinding process and thus expanding its technological capabilities.

Keywords: wheel cutting surface, contact area, spindle axis inclination, grinding depth, wheel diameter

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Corrosion Resistance of Plasma Nitrided and Nitrocarburized 42CrMo4 Steel

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This article deals with comparison of corrosion resistance of 42CrMo4 steel used for breech mechanism in the armament production. Increasing of demands on materials used for armament production and in other industrial application leads to the innovation of technologies in the field of surface treatment especially wear resistance, surface hardness, running-in properties and corrosion resistance. For the evaluation of experimental NSS corrosion resistance tests samples of 42CrMo4 steel were compared with plasma nitrided and nitrocarburized one. Individual 42CrMo4 steel samples were subsequently metallographically evaluated and characterized by hardness and microhardness measuring. The results and comparison of corrosion resistance of not-surface treated steel samples with plasma nitrided and nitrocarburized showed significant differences of corrosion rate. Due to different plasma nitriding conditions, there are corrosion resistance differences evident between the plasma nitrided steel samples as well. The corrosion resistance evaluation is supplemented by the surface corrosion-free surfaces evaluation using the laser confocal microscopy.

Keywords: Corrosion, plasma nitriding, nitrocarburizing, surface layer

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Evaluation of Tribological Properties by Using Different Process Fluid by Test Ball on Disc

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Manufacture of new parts of machineries, devices, etc., especially in engineering and metallurgy requires machining of the feedstock in a mechanical way. During machining occurs immediate contact between the tested specimen and the tool and in their mutual relative movement of friction and wear. One of the possible variants how to eliminate this fact is the application of process fluids during machining.
Currently, we are trying to simulate long-term testing by laboratory testing called tribology. The experiment presents friction between two materials that are under real sliding contact. This article examines the tribological characteristics between two materials (tool - ball and workpiece material - disc). The paper contains findings when examining process fluids by tribological test Ball – on - disc, this test is currently used in practice, very widespread, this test can imitate various operations of cutting machining. This paper deals with the evaluation of tribological properties (the coefficient of friction, wear of disc and wear of ball) between the ball from ceramic material Si_3N_4 and the test material (stainless steel X5CrNi18-10, EN 10088-3 and steel commonly used in engineering 16MnCr5, EN 10084-94) by using two kinds of process fluids.

Keywords: Tribology, steel, wear, coefficient of friction, lubricant

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Evaluation of the Parameters Affecting Passenger Riding Comfort of a Rail Vehicle

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The effort to increase the rail vehicle ride speed on existing tracks, or more precisely on modernized tracks with a lot of curves with a relatively smaller radius, lead to use of tilting mechanism of the vehicle body. The paper deals with simulation analysis of a rail vehicle with an active tilting system of the vehicle body, design of the rail vehicle in CAD program CATIA and dynamical analysis in program SIMPACK, with the RAIL expansion. Such body mounting on vehicle bogies is significantly more complicated than the design of conventional rail vehicles. The purpose of this type of body mounting is to increase the size of body tilt during ride in a curve and thus reduce the lateral unbalanced acceleration affecting the passengers, or allow higher driving speed in a curve with the same radius while keeping the lateral acceleration value respectively. Eight variants of different velocity, vehicle occupancy and setting of the tilting mechanism were analyzed. We determined the average value of passenger comfort N_{MV} from the simulation results. We have determined the value of passenger comfort during the ride in a curve P_{CT} from the simulation results.

Keywords: Passenger comfort, Dynamical model, Tilting mechanism, SIMPACK

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Selection of the Proper Diffusion Welding Parameters for the Heterogeneous Joint Ti Grade 2/AISI 316L

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The creation of the heterogeneous joints at materials with the different physical and mechanical properties is always problematic. As one of methods by which can be achieved very good results is there a diffusion welding. The aim of paper is to show the possibilities of diffusion welding utilization at creation the heterogeneous joints between Titan grade 2 and high-alloyed austenitic steel AISI 316L. The fundamental theory of diffusion and also scheme and realization of experimentally created diffusion welds in the thermal-mechanical simulator Gleeble® 3500 is described in the article. Furthermore, procedure of technological parameters selection when optimization of heterogeneous joint strength properties including metallographic evaluation are taken into account, are also presented.

Keywords: diffusion welding, Gleeble® 3500 and 3800, 316L steel, Ti Grade 2, processing parameters

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Jig Design for Welding of Wind Power Plant Component

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Article deals with design of welding jig for assembly of wind power plant component. Mainstay of article is design of welding jig, which makes exactly setting and reliable clamping of individual parts of welded desing possible for their complete welding. Design procedure of individual parts of welding jig is described in details in view of their functionality. Paper is especially focused on the parts of welding jig, which are necessary to make, including material selection of individual parts. Finally the technical and economic evaluation is carried out, approximate cost of jig is calculated and financial savings associated with practical use of welding jig are evaluated.

Keywords: welding jig, basic board, setting and clamping, vertical clamp

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Construction of Mechanic Regulation of Turbine Ventilator using Whirling Turbine

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An article deals with a definition, concept, development, calculation and construction of a prototype of mechanical regulation of a turbine ventilator using a whirling turbine reducing an amount of ventilated air.
The whole mechanical regulation solution is situated at a central shaft with arms. At low air velocity, a rotation nozzle is pulled out fully from its cover and works with a maximum suction capacity. The rotation nozzle starts to pull in its cover at higher air velocity, which protects the blades from push of air, which would slow down the whole turbine. A vertical move of the turbine is provided by an inner mechanism functioning basically as a centrifugal regulator. The advantage of this concept lies in not only suction regulation, but also protection of the rotation nozzle from a damage in case of adverse weather (the rotation nozzle stays inserted). The article describes individual development stages from a concept up to construction, including the final visualisation of the prototype solution of the mechanical regulation of the turbine ventilator using the whirling turbine.
The mentioned innovative solution of the mechanical regulation is very up-to-date thanks to its simplicity and non-service operation. It is just the matter of time when one of the producers would be interested in the turbine ventilator solution and it would be introduced into a market space.

Keywords: Turbine Ventilator, Whirling Turbine, Mechanical Regulation, Drained Air, Suction Capacity

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Development of Modern Railway Bogie for Broad Track Gauge – Bogie Frame Assessment

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This article is belonging to the publication series, which we published in the previous issues of this journal and there are described the most important and innovative research and development design solutions and computational procedures as part of European structural funds project. The main object of article is the strength test of new design of freight bogie frame through FEM analysis. For the calculation of the analyzed parts of the bogie through finite element the program ANSYS was used. Results of calculations prove, that new designed construction of the bogie frame satisfies strength conditions.

Keywords: Stress Analysis, Bogie Frame Verification, Computer Tools.

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Device for Applying a Thin Layer of Oil onto the Inner Surface of Steel Pipes

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The technological solution relates to the device for applying a layer of oil film to the inner surface of pipes of different cross section. It is suitable for metallurgical and engineering applications where it is required to use an oil film - a thin coating on the inner surface of pipes of different cross section and different lengths, due to: corrosion protection, disinfection, reducing the surface friction of the inner surface, or for other reasons. The formulation of this concept is applicable to a broad portfolio of pipe types of different sizes, cross-sections shapes and lengths. The technical solution falls within engineering and metallurgy fields.

Keywords: corrosion protection, tubes, pipes, oil film layer

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The Proposal How to Make the Basic Machining Technologies - Turning, Milling, Planing - More Productive

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The current manufacturing production is characterised by increasing level of automation, emerging of the new light-weight and high-stiff materials that are technologically difficult to produce. These trends have significant impact on production productivity. The automation has brought significant reduction of non-productive time (fast workpiece and tool exchange, automatic control of product quality during technological process). In this situation, the machining time becomes the limiting factor. In present, the reducing of the machining time is possible to make only by either significant changes in conventional technologies or application of new technological principle. However, these secondary solutions in some production section are not sufficient because it requires a global solution. An example of un-equal time continuity in link production is fact that one pressing machine with the time per one piece in seconds can supply dozen of lathes with the time per one piece in minutes. The paper provides also the proposal to the productivity increase of critical technologies as turning and milling.

Keywords: productivity, machining time, technology, automation, product, material

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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 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

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A Method of Computer-aided Modular Fixture Design, Part 2: Designing the Fixture under NC Manufacturing System

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This paper presents a new computer-aided method for modular-fixture design, in which the key point is building the fixture on the concept of NC Manufacturing System (NMS). In this paper, an approach of creation for a NMS is proposed, first to extract or setup the feature model of worktable of NC machine tool in any CAD system. Base on the worktable, the algorithm of computer-aided modular fixture design (CMFD) is then presented; the Post-NC verification to check the performance of modular fixture in NC machining is introduced at the last section of the paper. This method could help engineers to develop and employ an error-free modular fixture during the complex NC-manufacturing production.

Keywords: NMS, Bridge Joint (BJ), Worktable-based Design of Modular Fixture, Post-NC Verification

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Finite Element Analysis of the Delaminated Composite Plates Reinforced by Unidirectional Fibers

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Composite materials play an important role in the machine design. Laminated composites have a lot of advantages but in some cases they show different limitations that are caused by stress concentrations between layers. Discontinuous change of material properties is the reason for occurrence of interlaminar stresses that often cause delamination failure. Delaminations in layered plates and beams have been analysed by using both cohesive damage models and fracture mechanics. Modelling of composite structures by finite element (FE) codes to effectively model delamination is limited. Previous efforts to model delamination and debonding failure modes using FE codes have typically relied on ad hoc failure criteria and quasi-static fracture data. Improvements to these modelling procedures can be made by using an approach based on fracture mechanics. This approach allows us to predict the growth of a pre-existing crack or defect. A study of modelling delamination using the FE code ANSYS was conducted.

Keywords: Delamination, Composite, Energy Release Rate, FEM, ANSYS

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