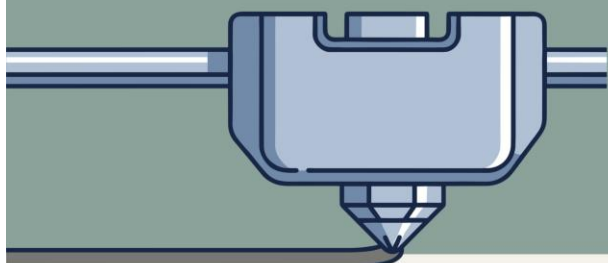




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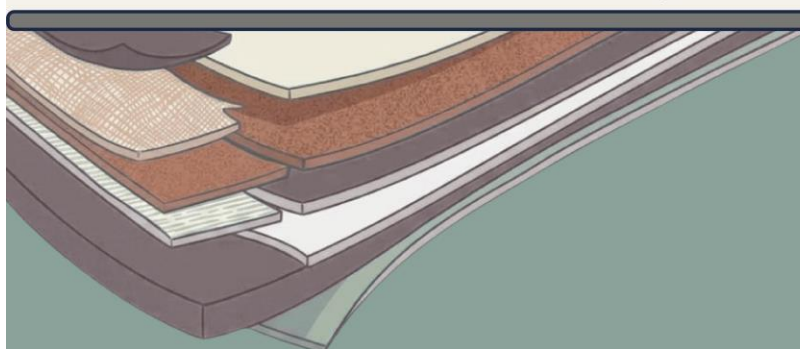
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COMAT 2026

BRAȘOV

Celebrating Two Decades



The 11th International Conference on
Advanced Composite Materials Engineering

22 -23 October

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COMAT 2026
**The 11th International Conference on
Advanced Composite Materials Engineering**

BOOK OF EXTENDED ABSTRACTS

20

YEARS OF COMAT | 2006–2026

Celebrating Two Decades

22–23 October 2026

Braşov, Romania

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Welcome to COMAT 2026

Dear Colleagues,

On behalf of the organizing team, I am delighted to welcome you to the 11th International Conference on Advanced Composite Materials Engineering, held at Transilvania University of Braşov on 22–23 October 2026.

This year, we celebrate twenty years of COMAT—an occasion to thank everyone who has contributed to the conference since 2006 and to look ahead to new research and collaborations in composite materials engineering.

COMAT 2026 brings together researchers and engineers to share recent findings in materials development, mechanical behavior, manufacturing, testing and modelling. We hope that the discussions will strengthen the links between experimental research, theoretical approaches and practical engineering applications.

The plenary lectures, oral presentations and poster sessions provide opportunities to exchange ideas, discuss current challenges and develop new partnerships. We particularly welcome young researchers and encourage them to take an active part in these discussions.

This Book of Extended Abstracts presents the scientific contributions to this anniversary edition. We hope it will serve as a useful reference during the conference and inspire further exchanges beyond the event.

I sincerely thank our invited speakers, authors, members of the scientific committee, organizing team and partners for their contributions and support.

I wish you a rewarding conference and a pleasant stay in Braşov.

Prof. Eng. PhD. Maria Luminița SCUTARU

President of the Organizing Committee
Head of the Department of Mechanical Engineering
Transilvania University of Braşov

Twenty years of COMAT

2006–2026

A conference is remembered through the ideas exchanged and the people who continue the conversation.

In 2026, COMAT celebrates twenty years since its first edition in 2006. This anniversary is an opportunity to reflect on the conference's development and to acknowledge the people who have contributed to it over the years.

Throughout its successive editions, COMAT has brought together researchers, academics and engineers with a shared interest in composite materials and their applications. Presentations and discussions have provided opportunities to exchange knowledge, compare research approaches and establish collaborations across institutions and countries.

The 11th edition continues this exchange, addressing current developments in materials, mechanical behavior, manufacturing, testing and modelling. Particular attention is given to engineering applications and the growing need for reliable, lightweight and sustainable structures.

We gratefully acknowledge the colleagues who helped establish COMAT and all those who have supported its subsequent editions. Our thanks go to the authors, invited speakers, scientific committee members, organizing teams and partners whose work has made each meeting possible.

The participation of young researchers is especially valuable to the future of the conference. Their involvement brings new ideas and perspectives to a community built through years of shared scientific interests.

As we celebrate this anniversary in Braşov, we look forward to continuing these exchanges and welcoming both longstanding colleagues and new participants to future editions of COMAT.

Celebrating Two Decades

Advanced Composite Materials Engineering
Braşov, Romania

SCIENTIFIC PROGRAMME

Plenary speakers

The plenary programme brings together invited contributions that open the scientific discussions of COMAT 2026. Extended abstracts of the lectures may be included in the scientific part of this volume.

Irina ARNĂUTU & Adriana SAVIN

Faculty of Industrial Design and Business Management, „Gheorghe Asachi” Technical University of Iași

National R&D Institute for Technical Physics, Iași, Romania

Cotton Yarns Twisted with Copper Used as Electromagnetic Shielding – Nondestructive Analysis of Structure

Dan ELIEZER

Department of Materials Engineering, Ben-Gurion University of the Negev, Israel

Materials Performance in Hydrogen Environments: Theory and Application.

Péter BENCS

Institute of Energy Engineering and Chemical Machinery, University of Miskolc, Hungary

Investigation of the Potential for Natural Gas Substitution with Renewable Gases in the Application of Thermal Energy Systems

Polidor Paul BRATU & Andrei TUDOR

ICECON S.A., Bucharest, Dunărea de Jos University of Galați, Romania

Leaf-Spring Mechanical Oscillator for Testing Seismic Protection Devices

Andrei VASILESCU

Technical University of Civil Engineering Bucharest, Romania

Remembering an Eminent Scientist: Professor Petre P. Teodorescu

Conference leadership and organization

Conference Chairman

Andreas ÖCHSNER

Esslingen University of Applied Sciences, Germany

President of the Organizing Committee

Maria Luminița SCUTARU

Transilvania University of Brașov, Romania

Dean of the Faculty of Mechanical Engineering

Ioan Călin ROȘCA

Transilvania University of Brașov, Romania

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Andrei Bencze · Eliza Chircan

Conference Secretary

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Scientific Committee

Costică ATANASIU

Peter BENCS

Paul Nicolae BORZA

Polidor Paul BRATU

Vasile NĂSTĂSESCU

Anghel CHIRU

Daniel CONDURACHE

Dan Mihai

CONSTANTINESCU

Eduard Marius CRĂCIUN

Carmen DEBELEAC

Nicuşor DRĂGAN

Hamid EL QARNIA

Gilbert-Rainer GILLICH

Maria Violeta GUIMAN

Nicolae HERIŞANU

Stanislav HOLÝ

Luděk HYNČÍK

Călin ITU

Károly JÁRMAI

Valeriu V. JINESCU

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Ahmed EL KHALFI

Eva KORMANIKOVÁ

Simona LACHE

Marin MARIN

Tiberiu Ştefan MĂNESCU

Mircea MIHĂLCICĂ

Arina Florenţa MODREA

Hassane MOUSTABCHIR

Mihaela Violeta MUNTEANU

Silviu NĂSTAC

Iuliu NEGREAN

Constantin OPRAN

Duc PHAM

Carmine PAPPALETTERE

Mircea RADEŞ

Ioan Călin ROŞCA

Milan RŮŽIČKA

Ioan Mihail SAVANIU

Maria Luminiţa SCUTARU

Mariana Domnica STANCIU

Nicolae Doru STĂNESCU

Roman ŞTURM

Ioan SZÁVA

György SZEIDL

Alexandru ŞERBAN

Horaţiu TEODORESCU

DRAGHICESCU

Oana TONCIU

Ovidiu VASILE

Andrei VASILESCU

Marian Nicolae VELEA

Sorin VLASE

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About this volume

Book of Extended Abstracts of the 11th International Conference on Advanced Composite Materials Engineering, COMAT 2026. Braşov, Romania, 22–23 October 2026.

Organized by the Faculty of Mechanical Engineering, Transilvania University of Braşov, through the Department of Mechanical Engineering.

The authors are responsible for the content and accuracy of their contributions.

Conference information and detailed programme

<https://comat.unitbv.ro/>

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Extended Abstracts

A BEAM-BASED MODAL FRAMEWORK FOR VIBRATION ANALYSIS OF PRINTED CIRCUIT BOARDS WITH ATTACHED COMPONENTS

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Abstract: Printed circuit boards (PCBs) carrying electronic components exhibit dynamic behavior influenced by mass distribution. This paper presents a beam-based modal approach for analyzing PCB-like structures with localized mass variations. The structure is represented by interconnected Euler–Bernoulli beams under clamped–clamped boundary conditions. Natural frequencies and mode shapes are determined and used to evaluate the modal equivalent mass. A localized mass increase is introduced to represent an electronic component and its effect on the natural frequencies is investigated. The results are validated against finite element analysis, showing close agreement for the first ten natural frequencies. The proposed framework provides an efficient basis for parametric investigations of component mass and location, with future extensions to different support configurations and multiple components.

Keywords: Printed circuit boards; Modal analysis; Euler–Bernoulli beams; Natural frequencies; Mode shapes; Modal mass; Localized mass.

ARTIFICIAL INTELLIGENCE-BASED ESTIMATION OF NATURAL FREQUENCIES IN DISCRETELY SUPPORTED PLATES

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Abstract: Plates carried on a small number of bolted connections are common in mechanical engineering, and their modal behavior depends as much on where the fasteners sit as on the plate itself. This paper examines how connection position governs the natural frequencies of a rectangular steel plate supported at six bolts. A frequency database covering 128 bolt layouts is generated from finite element analyses. Artificial neural networks are then trained on that database to predict the natural frequencies for new bolt layouts. Estimator accuracy is reported as a distribution rather than a mean value, and accuracy on known layouts differs markedly from that on new ones. The approach supports fixture design, vibration assessment, and digital-twin applications for bolt-mounted plate structures.

Keywords: natural frequencies, finite element analysis, artificial neural network

TIME-DEPENDENT EFFECTS OF HOT ACETONE VAPOR EXPOSURE ON THE TENSILE STRENGTH AND SHORE D HARDNESS OF FDM-PRINTED ABS PARTS

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Abstract: This paper investigates the influence of hot acetone vapor treatment on the tensile strength and Shore D hardness of acrylonitrile butadiene styrene (ABS) specimens fabricated via Fused Deposition Modeling (FDM). While previous studies demonstrate that this post-processing technique significantly enhances surface quality – reducing roughness by over 90% – its impact on mechanical performance requires further quantification. Consequently, this study examines specimens exposed to hot acetone vapors for short-term durations (measured in seconds). Tensile strength and Shore D hardness were evaluated according to ISO standards, followed by a comparative analysis of the mechanical response. The objective is to establish the correlation between treatment parameters and mechanical behavior to optimize the post-processing of FDM-printed components.

Keywords: FDM (Fused Deposition Modeling), ABS, hot acetone vapor treatment, tensile strength, Shore D hardness.

LEAF-SPRING MECHANICAL OSCILLATOR FOR TESTING SEISMIC PROTECTION DEVICES

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Abstract: This paper presents the technical evaluation of a seismic warning device integrated into a system capable of automatically initiating local protection actions. The technical capabilities of the device were experimentally investigated at ICECON using a mechanical test rig with an inverted elastic pendulum to generate controlled oscillations and determine the triggering threshold. The study tracks the verifiable trajectory from analytical grounding and response modeling of the experimental stand to laboratory validation, technical approval, and practical implementation of the product. The results highlight how cooperation between research institutes and industry can transform theoretical knowledge into validated technology applicable to earthquake risk reduction.

Keywords: seismic warning, controlled oscillations, inverted elastic pendulum, triggering threshold, laboratory validation, earthquake risk reduction

EXPERIMENTAL-NUMERICAL ASSESSMENT OF FDM-PRINTED PLA AND PETG SHELF BRACKETS

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Abstract: Fused Deposition Modeling (FDM) is increasingly used for manufacturing functional polymer components, yet relatively few studies examine the structural behavior of real engineering components through the correlation of experimental testing with finite element analysis. This paper presents an experimental–numerical assessment of FDM-printed shelf brackets made from polylactic acid (PLA) and polyethylene terephthalate glycol (PETG), in two structural configurations, with and without mounting holes. The brackets were experimentally tested in bending, while the numerical models were developed in Altair HyperMesh and analyzed using the OptiStruct solver, under loading conditions equivalent to the experimental ones. The numerical results were consistent with the experimental results, with deviations in maximum stress ranging from 0.69% to 8.16%. The PLA brackets exhibited higher mechanical strength than the PETG ones, and for both materials the configuration with mounting holes recorded higher load and maximum stress values compared to the configuration without holes. After validation, the numerical model was used to assess the behavior of the brackets under representative operating conditions and to identify critical stress zones. The proposed methodology highlights the usefulness of correlating experimental testing with numerical simulation for the structural evaluation of functional FDM components.

Keywords: polymer, FDM 3D Printing, FEA Analysis, bracket, PLA, PETG

INTERACTIVE TOOL FOR BOUNDARY LAYER TRANSITION AND DRAG ESTIMATION: COUPLED MODELLING OF TURBULENCE AND SURFACE ROUGHNESS EFFECTS IN XFLR5

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Abstract: The aerodynamic performance of airfoils operating at low-to-medium Reynolds numbers is highly sensitive to the location of boundary layer transition, a process governed in XFOIL/XFLR5 panel codes by the N_{crit} amplification exponent. This paper introduces an interactive computational tool designed to estimate and quantify N_{crit} degradation under the combined influence of freestream turbulence intensity T_u and surface roughness height (k).

Keywords: Reynolds number, XFLR5 software, turbulence intensity, surface roughness

FATIGUE ANALYSIS OF THE CONTACT BETWEEN THE MOVABLE RING AND THE SEAT OF A HIGH-PERFORMANCE SPHERICAL VALVE

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Abstract: This paper presents a numerical fatigue assessment of a movable-ring/seat sealing assembly under a zero-based pressure cycle. A finite element model was developed for four material combinations, with local mesh refinement in the sealing-contact region. The stresses in the functional sealing band were below the fatigue-strength values of the adopted S–N curves, so the predicted life reached the upper limit of these curves in all cases. The global minimum-life values were associated with a stress singularity outside the sealing region and were not used for comparison. Therefore, all combinations met the required design life, but fatigue results alone did not allow a unique material ranking.

Keywords: fatigue analysis, sealing system, finite element analysis (FEA), material selection

OPTIMIZATION OF INJECTION MOLDING PARAMETERS FOR SURFACE DEFECT REDUCTION IN PC/ABS AUTOMOTIVE COMPONENTS: A COMPARATIVE STUDY USING VIRGIN AND RECYCLED MATERIALS

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Abstract: This research presents a comparative evaluation of the influence of injection molding parameters on the surface defects of the main housing of an automotive air ventilation outlet. Two thermoplastic materials from the PC/ABS family (Covestro) are investigated: Bayblend T85 X and its sustainable variant, Bayblend T85 X R25, which contains 25% pre-consumer recycled polycarbonate. The use of these two materials allows for a direct comparative analysis under identical technological conditions, on the same component, utilizing a Zhafir ZE3000-1100 injection molding machine and a dedicated mold. The experimental study investigates the effects of melt temperature, mold temperature, and injection speed within intervals validated through preliminary trials. The results aim to identify the optimal processing windows that ensure surfaces compliant with automotive industry standards, while simultaneously evaluating whether the introduction of the recycled material alters the processing behavior of the polymer.

Keywords: PC/ABS, Injection molding, Surface defects, Automotive components, Recycled polymers, Process optimization

DIGITAL EVALUATION OF COMPACTION PERFORMANCE

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Abstract: Improving the efficiency of ground improvement processes currently demands a transition toward advanced and digitalized quality control methods. This paper proposes a new methodology for evaluating soil compaction performance (particularly for weakly cohesive soils), based on establishing complex inter-parametric correlations between laboratory tests and in situ experimental investigations. The research results in the development and validation of a dedicated software program, designed as a predictive analysis tool for the mechanical behavior of the soil during the compaction process. The implemented algorithm evaluates the real-time dynamics of the machine-soil interaction, monitoring a series of fundamental indicators, such as static longitudinal modulus, dry density, average moisture content, roller-soil contact patch width, compressive stress, soil reaction force, soil stiffness evolution, compaction degree, settlement, and the number of passes. The results demonstrate that the digital monitoring of a specific set of parameters related to soil behavior under the action of compaction equipment provides precise indicators regarding the increase in bearing capacity and the achievement of the optimum compaction degree, significantly reducing the time and costs associated with traditional testing. Thus, this paper makes an important contribution to the field of geotechnical engineering by offering a viable digital solution for the intelligent and continuous quality control of earthworks.

Keywords: soil compaction, weakly cohesive soils, inter-parametric correlations, software program, compaction degree, settlement

THE INFLUENCE OF DAMAGE SEVERITY ON A CONTINUOUS BEAM WITH A MID-SPAN HINGE REGARDING DYNAMIC BEHAVIOR

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Abstract: The paper focuses on the dynamic behavior of a continuous beam with two spans, upon the appearance of a continuous discontinuity across the entire width of the beam and upon the deepening of the damage. Using the finite element method, for a beam with two spans clamped at both ends and with an intermediate support of the hinged type in the middle, the natural frequencies are determined both in the reference state, without a damage on the beam, and by introducing the damage on the beam by varying its depth, damage that can be located anywhere on the beam.

Keywords: Dynamic behavior, numerical method, continuous beam, natural frequencies.

EFFECT OF HOT ACETONE VAPOR TREATMENT DURATION ON THE TENSILE PROPERTIES OF FDM-PRINTED ABS SPECIMENS

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Abstract: This study evaluates the influence of hot acetone vapor treatment duration on the tensile strength and elongation at break of ABS specimens fabricated by Fused Deposition Modeling (FDM). Forty specimens were divided into eight groups of five, comprising an untreated reference group and seven groups treated at 60 °C for 15–105 s. Treatment reduced the mean tensile strength from 34.73 MPa to 29.54–32.34 MPa, while elongation at break increased from 4.54% to 5.93–8.00%. Strength losses ranged from 6.88% to 9.09% for exposures of 15–60 s and from 13.71% to 14.94% for 75–105 s. The lowest mean strength loss occurred at 45 s. These findings support selecting treatment duration according to the mechanical requirements of FDM-printed ABS components.

Keywords: FDM (Fused Deposition Modeling), ABS, hot acetone vapor treatment, tensile strength, elongation at break.

CORRELATIONS BETWEEN TENSILE, FLEXURAL AND COMPRESSIVE BEHAVIOUR OF CROSS-PLY AND QUASI-ISOTROPIC AUTOCLAVED FLAX BIO-EPOXY COMPOSITES FROM BIAXIAL MATERIALS

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Abstract: Flax fibers used as reinforcement in bio composites are gaining popularity due to their cost-effectiveness and mechanical properties comparable to those of glass fibers. Flax-based bio composites featuring cross-ply and quasi-isotropic stacking sequences—specifically [0/90]₄, [+45/-45/0/90]_s, and [+45/-45]₄—were analyzed. A correlation is presented between their mechanical behavior and the influence of the stacking sequence on their properties. The experimental results were validated using the Finite Element Method with Ansys 2022R1 software. The fiber microstructure, mechanical properties and configuration are examined, alongside the properties of the plant-based epoxy resin; furthermore, ultrasonic structural analysis indicates the absence of discontinuities or porosity.

Keywords: mechanicals tests, flax bio-composite, nondestructive method, microstructure

BRAKING ENERGY RECOVERY. FLYWHEEL OPTIMIZATION

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Abstract: This study investigates the recovery of braking energy using a flywheel-based energy storage system, with the aim of improving vehicle energy efficiency. During conventional braking, an amount of kinetic energy is dissipated as heat, particularly in urban driving conditions. A 3D CAD model of the flywheel-based system was developed to define its geometry and mechanical configuration, followed by an AMESim simulation to evaluate its dynamic behavior and energy recovery performance. The influence of parameters, including vehicle speed, flywheel rotational speed, and stored energy, was investigated under different operating conditions. The simulation results were analyzed and presented graphically, allowing the performance of the system and the influence of the investigated parameters to be evaluated. The study highlights the potential of flywheel systems for regenerative braking applications.

Keywords: regenerative braking, flywheel energy storage, energy recovery

THREE-POINT BENDING BEHAVIOR OF FDM-PRINTED TOUGH PLA-TPU MULTILAYER STRUCTURES

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Abstract: The aim of this paper is to analyze the dimensional characteristics, mass, Shore D hardness, and three-point bending response of Fused Deposition Modeling (FDM) printed specimens manufactured from Tough PLA, TPU, and a symmetric Tough PLA-TPU-Tough PLA-TPU-Tough PLA multilayer architecture. The multilayer specimens contained equal nominal volumes of Tough PLA and TPU and a symmetric 3/6/6/6/3-layer sequence. Dimensional measurements, mass determination, hardness testing, and flexural tests were performed. The results show that the multilayer architecture provides a mechanical response intermediate between the rigid Tough PLA and highly deformable TPU specimens. The multilayer specimens exhibited surface hardness and load-bearing capability below those of monolithic Tough PLA but substantially above the corresponding response of TPU, while retaining greater deformability than Tough PLA.

Keywords: fused deposition modeling; Tough PLA; thermoplastic polyurethane; multi-material printing; three-point bending

OPTIMIZATION ASSESSMENT OF A SINGLE-AISLE AIRCRAFT FLOOR CROSSBEAM

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Abstract: The floor crossbeam is a primary structural member of large aircrafts, transferring cabin loads from the seats to the fuselage frames and the Z-struts. This paper investigates the weight reduction potential of an aluminium alloy crossbeam by combining classical strength-of-materials calculations, finite element analysis and topology optimization. Four critical load cases, defined according to the Certification Specifications CS-25 and including inertial forces, cabin differential pressure and emergency landing conditions, are applied to a model with realistic constraints at the crossbeam attachment points. The baseline was calculated considering an I-section beam, reinforced with vertical stiffeners and locally adjusted wall thicknesses. The beam was then optimized using FEA. Two formulations were compared: mass minimization subject to the stress limit, and compliance minimization at a volume fraction. Both were run with double symmetry, a minimum member size and a manufacturing constraint. The optimized beams have smaller masses relative to the baseline, with stresses remaining below the allowable limit. In both cases the flanges are largely preserved, while the web develops into a truss-like structure. These results indicate that topology optimization can provide substantial mass savings for primary-load-path components of the cabin floor structure.

Keywords: floor crossbeam, topology optimization, flight loads, finite elements analysis (FEA), weight reduction;

ANALYSIS OF A PREDICTIVE MODEL FOR ACOUSTIC ABSORPTION IN SOUND ABSORBING MATERIALS

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Abstract: The paper presents a MATLAB implementation of the Delany-Bazley model for evaluating the acoustic performance of sustainable materials used in road and railway noise barriers. A comparative numerical analysis is performed for different materials and panel thicknesses over the frequency range of 125-4000 Hz. The obtained results contribute to the assessment and optimization of environmentally friendly noise barrier solutions.

Keywords: sustainable materials, noise barriers, numerical analysis.

ITERATIVE DESIGN AND EXPERIMENTAL PERFORMANCE EVALUATION OF A 12-DOF OPEN-SOURCE QUADRUPEL ROBOT

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Abstract: This paper presents the design, development, and experimental evaluation of a 12-degree-of-freedom open-source quadruped robot developed through two successive design iterations. The first prototype, based on the SpotMicroAI architecture, revealed limitations related to actuator torque, external power supply requirements, and control update frequency. The second prototype incorporated inverse kinematics and gait generation models adapted from OpenQuadruped, higher-performance actuators, an onboard power supply, and a redesigned electronic architecture. The methodology combined functional simulation with experimental validation of the mechanical and control solutions. A comparative evaluation based on consistent performance criteria demonstrated an eightfold increase in control update frequency, more than twice the available actuator torque margin, and approximately one hour of operating autonomy. The results highlight the effectiveness of iterative engineering optimization and demonstrate the platform's potential for experimental research, robotics education, and the development of monitoring applications in construction engineering.

Keywords: Quadruped robot, iterative design, inverse kinematics, gait control, simulation, experimental validation, open-source robotics

PASSIVE CREW PROTECTION SYSTEMS

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Abstract: This paper investigates composite spall liners as passive protection elements for reducing secondary fragmentation inside armoured vehicles. Kevlar, carbon-fibre and hybrid carbon-Kevlar laminates were manufactured and subjected to tensile tests, and their main mechanical properties were compared after normalization to a common fibre-volume fraction. A finite-element model was then developed in Altair HyperMesh/ Radioss to compare impact response with and without an internal composite layer. Finally, carbon and Kevlar plates were subjected to impact tests to correlate numerical observations with the real damage mechanisms. The results show that carbon provides higher stiffness, whereas Kevlar exhibits more progressive deformation and energy absorption. The numerical and experimental results support the use of Kevlar-based or hybrid solutions for limiting secondary-fragment effects.

Keywords: spall liner, Kevlar, carbon fibre, ballistic impact, finite element analysis

DESIGN AND IMPLEMENTATION OF A HYBRID PROOF-OF-CONCEPT MODEL FOR THE KINEMATIC ANALYSIS OF AN INTERNAL COMBUSTION ENGINE WITH VARIABLE VALVE TIMING

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Abstract: Prototyping internal combustion engines (ICE) equipped with advanced gas exchange systems, such as Variable Valve Timing (VVT) and Variable Valve Lift (VVL), presents significant engineering and manufacturing challenges. This paper details the multidisciplinary approach used to design, simulate, and manufacture a 1:1 scale hybrid physical model of a four-cylinder ICE. The methodology focuses on the kinematic design of the valve actuation mechanisms, specifically the integration of multi-profile camshafts, modular tappets, and a manually actuated helical-gear dephaser. To overcome the build volume limitations of Fused Deposition Modelling (FDM) desktop 3D printers, advanced segmentation techniques and Design for Additive Manufacturing (DfAM) principles were applied. The final proof-of-concept merges PLA printed components with metallic elements, bearings, and an electro-mechanical drive system, validating the feasibility of creating complex, functional kinematic prototypes for educational and conceptual demonstration.

Keywords: Variable Valve Timing, FDM 3D Printing, Internal Combustion Engine, Proof-of-Concept, Design for Additive Manufacturing.

NUMERICAL ANALYSIS OF THE ROLE OF AIRBAGS IN AUTOMOTIVE PASSIVE SAFETY

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Abstract: This paper investigates the role of the automotive airbag system in reducing occupant injury during frontal impact conditions. The study first presents the main components, operating principles, and potential injury mechanisms associated with airbag deployment. A numerical model of the airbag system was developed in order to evaluate its inflation behavior and the evolution of relevant physical parameters. The analysis was subsequently extended to a frontal impact simulation based on a physical test stand available at the Research and Development Institute of Transilvania University of Braşov. Several impact scenarios were considered, including an inactive airbag, a normally activated airbag, and a case in which the occupant was positioned excessively close to the airbag. The simulations were performed for a frontal impact at 35 km/h, with particular attention given to the dynamic response of the dummy head. Head acceleration was used as one of the main parameters for comparing the analyzed configurations. The results showed clear differences between the scenarios, particularly regarding the magnitude and duration of the accelerations experienced during impact.

Keywords: automotive airbag, passive safety, frontal impact, numerical simulation, occupant protection.

COTTON YARNS TWISTED WITH COPPER USED AS ELECTROMAGNETIC SHIELDING – NONDESTRUCTIVE ANALYSIS OF STRUCTURE

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Abstract: Conductive yarns incorporated into textile structures, particularly woven and knitted fabrics, are preferred for applications involving antistatic protection, electromagnetic shielding, and explosion-risk prevention. A compound woven fabric made of cotton yarns twisted with metallic copper filaments (CO–Cu) exhibits high electromagnetic (EM) shielding performance, achieving an EM radiation attenuation of 30–50 dB and functioning as a flexible „Faraday cage”. The paper addresses the non-destructive evaluation of woven fabric integrity using EM methods. The analysis considers both the EM properties of the CO–Cu material and the structural characteristics of the woven fabric. The paper presents the method for determining the *S* parameters necessary for determining the shielding effectiveness due to reflection/ transmission/ absorption.

Keywords: conductive yarn, multiple layer weave, ArahWeave, simulation; *S* parameters

LASER POWDER BED FUSION OF 316L STAINLESS STEEL: PROCESS–STRUCTURE–PROPERTY RELATIONSHIPS AND IMPLICATIONS FOR AEROSPACE APPLICATIONS

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Abstract: Laser powder bed fusion (LPBF/PBF-LB/M) enables dense, complex 316L stainless-steel parts but creates a hierarchical non-equilibrium microstructure. This critical review synthesizes 38 publications from 2020–2026 using a process–structure–property framework with emphasis on aerospace-relevant evidence. Insufficient energy input is consistently associated with lack-of-fusion defects, whereas excessive input can promote keyhole porosity. Cellular structures, dislocation networks, texture and oxide particles support high strength and ductility, but anisotropy, surface condition and residual stress remain important. Fatigue is more defect- and surface-sensitive than static strength, and corrosion depends on environment, microstructure and post-processing. The main aerospace challenge is demonstrating repeatable, inspectable and statistically defensible performance across machines, powder lots, orientations and service environments.

Keywords: laser powder bed fusion; 316l stainless steel; microstructure; fatigue; aerospace

EXTENDED ANALYSIS OF THE INTERNAL STRUCTURE OF PARTS MANUFACTURED FROM 316L STEEL USING SLM AND AI-ASSISTED METHODS

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Abstract: Selective Laser Melting (SLM) enables the manufacturing of metallic parts using successive layers of powder. In a previous study, the internal structure of 316L parts manufactured with 30 and 50 μm layer thickness was examined by optical microscopy and the visible regions were manually identified according to their shape. This paper presents an extended analysis of the same images using ChatGPT-assisted Python procedures. From 550 manually identified regions, 542 individual masks were recovered from Photoshop files. The regions were analyzed by their neighboring contacts, orientation and internal image texture. A separate K-means classification was then compared with the manual results. The analysis identified 1,205 contacts between regions, while the classification agreement was 61.4%. The proposed methods provide additional information about the structure visible in the images, without changing the original photographs.

Keywords: selective laser melting; 316l stainless steel; image analysis; internal structure; chatgpt

DESIGN OF A PASSIVE KNEE EXOSKELETON MANUFACTURED BY 3D PRINTING

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Abstract: This paper presents the design, sizing, numerical assessment, material characterization and prototyping of a passive FDM knee exoskeleton. A spring-cable-pulley mechanism stores elastic energy during knee flexion and returns part of it during extension. The device was sized for a 70 kg, 173 cm user and a 15% assistance target, corresponding to 5.67 N·m. PETG tensile tests gave a tensile strength of approximately 41.97 MPa and a Young's modulus of 2105 MPa. Multibody analysis predicted a maximum pulley reaction of about 360 N, while static FEA and flexible-body analyses gave maximum stresses of 32.05 MPa and 23.41 MPa. A physical prototype confirmed manufacturability and mechanical integration. The results support structural feasibility for the investigated loading cases; biomechanical effectiveness remains future work.

Keywords: passive exoskeleton; knee joint; FDM; PETG; spring-cable-pulley mechanism.

MATHEMATICAL MODEL FOR TWO-DIMENSIONAL MECHANICAL SYSTEMS WITH VOIDS

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Abstract: This paper presents an analytical model for two-dimensional mechanical systems containing voids. The presence of voids is described by introducing the volume fraction of the material into the formulation. The kinematics of the elastic body is expressed using finite element shape functions, while the kinetic and potential energies are established by taking into account the contribution of the voids. The equations of motion are then derived using the classical Lagrange formalism of analytical mechanics. The proposed formulation provides a general mathematical framework for describing the motion of planar elastic mechanical systems with voids and can be applied to multibody systems containing such structural components. The approach is particularly relevant to engineering systems in which voids may occur naturally during manufacturing or may be intentionally introduced into the material.

Keywords: FEM; MBS; bi-dimensional element; analytical dynamics; voids

MODAL ANALYSIS OF LINEAR VISCOELASTIC DYNAMIC SYSTEMS WITH DISCRETELY VARIABLE STIFFNESS UNDER HARMONIC EXCITATION

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Abstract: The modeling of dynamic processes under harmonic excitation can be carried out for multi-body systems with linear viscoelastic connections and discretely variable stiffnesses. It is highlighted that certain expected resonance states can be attenuated to near total suppression, while others remain significantly robust. Consequently, modal analysis reveals notable modal motions under discretely variable stiffness conditions.

As a result, specific cases involving the mitigation or complete elimination of anticipated resonance states can be distinguished. Under forced vibration regimes with variable frequency, predicted resonance states are entirely absent for technological processes of interest a phenomenon frequently observed in industrial and structural engineering applications.

Keywords: modal analysis, multibody system, discrete variable stiffness

COMPARATIVE STRUCTURAL ANALYSIS OF SOUND-ABSORBING PANELS USED IN ROAD TRAFFIC NOISE BARRIERS

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Abstract: This paper presents a comparative structural analysis of three configurations of sound-absorbing panels used in road traffic noise barriers. The investigated configurations consist of panels with continuous horizontal slots, vertical slots, and segmented horizontal slots. The numerical analysis was performed using the Finite Element Method (FEM) in Autodesk Inventor. The structural response of the three configurations was evaluated under aerodynamic and snow - removal loading conditions in terms of equivalent von Mises stress, total displacement, and factor of safety. For aerodynamic loading, four airflow velocities were considered, while two loading conditions corresponding to snow-removal operations were investigated. The results show that the continuous horizontal-slot and vertical-slot configurations exhibit very similar structural behavior. In contrast, the segmented horizontal-slot configuration shows higher von Mises stress and lower factors of safety. Overall, the continuous-slot configurations provide the most consistent structural performance.

Keywords: sound-absorbing, noise barriers, structural analysis, Finite Element Method, mechanical behavior.

DESIGN, MANUFACTURING, AND ASSEMBLY STRATEGIES FOR LARGE-SCALE COMPONENTS IN INTERNAL COMBUSTION ENGINE PROTOTYPING USING FDM TECHNOLOGIES

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Abstract: Prototyping internal combustion engines (ICE) using Fused Deposition Modelling (FDM) presents significant challenges due to the scale and complexity of the components. This paper presents the design, manufacturing, and assembly strategies applied to a 1:1 scale physical model of an ICE equipped with a variable valve timing and lifting systems. Overcoming the build volume limitations of common desktop 3D printers required advanced segmentation techniques, specific joining methods, and Design for Additive Manufacturing (DfAM) principles. The results validate the feasibility of creating functional kinematic prototypes using PLA, providing an accessible pathway for educational and conceptual validation.

Keywords: Additive Manufacturing, FDM, Internal Combustion Engine, Design for Assembly, Prototyping.

EVALUATION OF DYNAMIC AND MECHANICAL CHARACTERISTICS OF ANTI-SEISMIC DEVICES AND ELASTOMERIC BEARINGS USING A MULTIFUNCTIONAL SYSTEM DEVELOPED UNDER CONTRACT 32 PTE / 2025

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Abstract: *This paper presents the methodology for the experimental evaluation and numerical determination of dynamic stiffness, damping capacity, and mechanical behavior for an extended range of anti-seismic devices and elastomeric structural bearings. The analyses and determinations are performed using a newly developed multifunctional test system, designed and implemented within the framework of the PTE project (Contract no. 32 PTE / 2025). The new test stand provides advanced simulation conditions for static and dynamic loadings, strictly adhering to the technical and methodological requirements specified by the international and European reference standards ISO 15129 ("Anti-seismic devices") and EN 1337-3 ("Structural bearings - Part 3: Elastomeric bearings"). Thanks to the extended technical capabilities of the experimental setup, the system enables precise characterization of viscoelastic properties, shear and compressive stiffness, and energy dissipation capacity under variable dynamic regimes. The implemented testing procedures combine high-resolution data acquisition with calibrated numerical models, offering an integrated approach for structural performance validation. The results demonstrate the equipment's versatility in testing a wide variety of isolators and bearings, ensuring compliance with current seismic regulations and opening new perspectives for the research and optimization of modern seismic protection devices.*

Keywords: *Anti-seismic devices, elastomeric bearings, dynamic stiffness and damping, multifunctional testing system.*

BOUNDARY LAYER TRANSITION PARAMETER ESTIMATION IN XFLR5: A CALIBRATION METHODOLOGY FOR N_{crit} BASED ON WIND TUNNEL TURBULENCE AND SURFACE ROUGHNESS

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Abstract: Accurate prediction of aerodynamic performance at low-to-medium Reynolds numbers using coupled panel/boundary-layer solvers (XFOIL/XFLR5) critically depends on the correct selection of the N_{crit} parameter within the e^N amplification method. This paper presents an analytical and empirical methodology for calibrating N_{crit} , accounting for both the freestream turbulence level of the testing environment and the disturbance effects induced by surface roughness (e.g., additively manufactured airfoils).

Keywords: boundary layer, XFLR5 software, surface roughness, Reynolds number

METHODS FOR ANALYZING ACOUSTIC PARAMETERS INSIDE PREMISES

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Abstract: This paper presents a numerical study of the acoustic field in a rectangular parallelepiped enclosure with rigid walls. The analysis is based on the acoustic wave equation and focuses on determining the natural frequencies and spatial distribution of acoustic pressure, including the identification of nodal surfaces. The influence of the enclosure height on its acoustic modes is investigated for different geometric configurations. The theoretical relationships are implemented in MATLAB/GNU Octave using numerical and spectral analysis methods. The obtained results highlight the dependence of the natural frequencies and acoustic field distribution on the enclosure geometry. The proposed approach demonstrates the applicability of numerical methods for the analysis and prediction of acoustic behavior in enclosed spaces.

Keywords: room acoustics; numerical methods; Matlab/GNU Octave.

Poster Abstracts

CAD MODELING, NUMERICAL AND EXPERIMENTAL MODAL ANALYSIS OF A REINFORCED CONCRETE BRIDGE WITH VISCOUS-ELASTIC NEOPRENE SUPPORT DEVICES

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Abstract: The paper presents the modal analysis of a reinforced concrete bridge subjected to external dynamic actions from road traffic or seismic movements. The bridge is modelled as a 6DOF solid-body with triortogonal viscoelastic bearings that schematize the neoprene support devices.

A series of experimental results obtained from "in-situ" dynamic tests are presented, using the virtual instrumentation technique developed by the scientists of the Mechanics of Machines and Technological Equipment Research Center – MECMET, Faculty of Engineering and Agronomy of Braila. A set of tests were performed to determine the response of the viaduct structure to dynamic traffic forces (shocks, vibrations).

Keywords: modal analysis, reinforced concrete bridge, 6DOF solid-body

ON FRACTIONAL CALCULUS APPLICATION FOR BEHAVIORAL CHARACTERIZATION OF ELASTOMERIC VIBRATION ISOLATORS

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Abstract: This paper presents a concise overview of several types of computational models based on fractional calculus, with direct applications in modeling and simulating the behavior of elastomeric vibration-isolation elements. The studies aimed to assess operational capability, the maintenance of structural integrity during service, and functional compliance. The primary assumptions addressed the use of vibration isolators under intense and varied dynamic conditions, including peak loads and sudden load fluctuations. The main conclusion is that this computational approach is suitable for replacing the nonlinear models widely used for the realistic simulation of rubber-based vibration isolator behavior.

Keywords: fractional calculus, α -derivative, rubber-based composites, vibration isolation, operational capability, structural integrity, functional compliance

SPECIFIC ASPECTS OF THE MODAL RESPONSE OF AN OLD PIANO SOUNDBOARD

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Abstract: *Grand piano soundboards are complex structures made of resonance wood, characterized by structural elements with varied geometries and internal configurations. Consequently, their modal response is strongly influenced by both geometric shape and a range of factors such as wood type, grain orientation, age, the fastening methods used for structural elements, surface finishing, and so on. For a piano of considerable age, the effects of aging on both the wood material and the joints between structural elements must also be taken into account. This paper presents results obtained via experimental modal analysis (EMA) on the soundboard of a short grand piano. The soundboard was removed from the piano structure and tested under laboratory conditions, adhering to the support and excitation parameters specific to the EMA method. The results are presented in a structured manner, corresponding to the specific analysis scenarios considered.*

Keywords: *piano soundboard, resonance wood structure, tonewood, Experimental Modal Analysis (EMA), stabilization diagram, Prony's method, Least-Squares Complex Exponential (LSCE) method*

INVESTIGATIONS REGARDING THE SPECIFIC MODAL RESPONSE OF COMPOSITES WITH SPECIAL REINFORCEMENT INCLUSIONS

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Abstract: *This study addresses the particularly interesting issue of the specific modal response of structural elements made from composite materials containing special reinforcing inclusions. Modal behavior in such cases depends on the material's internal structure and configuration, as well as on the directions of the dynamic excitation and the response measurement. To identify the changes in modal response induced by the reinforcing inclusions, the analysis considered both the initial and the enhanced versions of the composite. Experimental techniques were employed in conjunction with computational analyses. The main conclusions highlight specific modal characteristics identified at both the local level and within the structural element as a whole.*

Keywords: *composites, reinforcement inclusions, Experimental Modal Analysis (EMA), stabilization diagram, Least-Squares Complex Exponential (LSCE) method, Prony's method*

CAD MODELING AND DYNAMYC ANALYSIS OF REINFORCED CONCRETE PLATFORM FROM ELI-NP MAGURELE-ROMANIA

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Abstract: The paper presents the results obtained from the dynamic modal analysis of a very large reinforced concrete platform (120X120 meters, over 50,000,000 kg) with multiple neoprene rubber supports. The results of the modal analysis are useful in the study of anti-vibration isolation problems of very large masses, subjected to dynamic or seismic forces.

The model of the reinforced concrete support platform supported by support devices considers in a first approach a 6DOF solid-body, placed on elastic supports. This modeling method does not take into account the elasticity of the concrete from which the platform is made. Following the calculation performed, in a first approximation, six natural vibration modes (natural frequencies, natural vectors) were obtained. With the help of these results, which describe the rigid-body movement of the platform, a first evaluation of the vibrations of this system can be done. These results can be useful to mechanical engineers or students for a preliminary design of the platform.

Keywords: modal analysis, inertial platform dynamics

BOUC-WEN BILINEAR RHEOLOGICAL MODEL FOR ELASTOMERIC SEISMIC ISOLATORS

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Abstract: The evaluation method consists of raising the hysteretic loop on the dynamic stand Project PTE-2024-0384 for comparison with the Bouc-Wen loop and evaluating the deviations until the convergence of the experimental parameters is reached. The constitutive equations for the Bouc-Wen model can be completely defined parametrically based on the experimental results.

In this case, the Bouc-Wen rheological model, being validated, can be integrated into the equations of motion of the building resting on the seismic isolators. In this case, the dynamic response to seismic excitations can be evaluated in both the time and frequency domains, thereby establishing a mechanical analysis method for similar computational models.

Keywords: bilinear model, Bouc-Wen, seismic isolator, elastomer

THE INFLUENCE OF THE AGE OF VIOLIN MATERIALS ON THE OPERATIONAL ACOUSTIC CHARACTERIZATION OF A CONCERT HALL

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Abstract: *This specific study is part of a broader set of experimental and computational investigations aimed at evaluating the specific characteristics of certain categories of violins under operational conditions in a concert hall, while also identifying the hall's acoustic properties in relation to the type and acoustic signature of the instrument played. The violins examined in this study include both heritage instruments and contemporary ones (no more than one year old). To ensure consistency, a single violinist performed the tests. The results presented here briefly outline how the acoustic signature of the instrument influences the assessment of the concert hall's potential acoustic characteristics. Furthermore, a key conclusion is that, beyond the standard-based identification of a concert hall's acoustic properties, the audience's subjective acoustic response also depends on the intrinsic performance of the instrument being played.*

Keywords: *acoustics, violin, concert hall, Sabine model, Eyring model, reverberation time, clarity, spectral Kurtosis, computational techniques*

FOAM-FORMED CELLULOSE-BASED MATERIALS FOR NOISE MITIGATION PANELS - COMPUTATIONAL ACOUSTICS APPROACHES

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Abstract: *This study addresses the use of cellulose-fiber-based foam materials in specific applications involving sound-attenuating panels. The paper presents key aspects of computational acoustics as applied to these low-density, eco-friendly materials. It was considered both empirical Delany–Bazley model and its variants, and Johnson–Champoux–Allard phenomenological group of models. Additionally, it was supposed the Prediction of Sound Absorption Coefficient using the Transfer Matrix Method (PSAC–TMM). In order to evaluate transport properties the Lattice Boltzmann Method – LBM was taken into account, and some practical examples using LBM were presented. The results obtained are presented comparatively across the various models and approaches considered. The study's conclusion is based on the differences between numerical and experimental results, highlighting error levels in relation to the type of model used.*

Keywords: *foam-formed porous materials, cellulose fibers, acoustics, computational techniques, Lattice Boltzmann Method (LBM), PSAC–TMM, soundproofing*

MULTIFUNCTIONAL DYNAMIC TEST RIG FOR SEISMIC PROTECTION DEVICES DEVELOPED AT ICECON BUCHAREST

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Abstract: Within ICECON, the multifunctional dynamic stand for the SREN15129 standard was created, with the aim of awarding the CE marking. In this context, it is noted that technical design and testing solutions have been conceived for dynamic forces of 1500–2000 tf, intended for anti-seismic devices with a maximum diameter of 1.0 m and a maximum height of 0.6 m.

Keywords: antiseismic, tests, dynamic stand

EVALUATION OF LRB SEISMIC ISOLATORS USING A COMBINED NUMERICAL- EXPERIMENTAL METHOD ON THE MULTIFUNCTIONAL DYNAMIC TEST RIG

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Abstract: This paper deals with the acceptability criteria for the agreement between the parametric values obtained through tests and the stable design values based on the calculation relationships formulated and applied by the authors of the article. The validation procedure is based on the use of the multifunctional dynamic stand.

The experimental and numerical values for seismic isolators produced by FPC (ALGA) Italy and FIP Italy were analyzed based on the criteria of parametric and numerical agreement and acceptance in accordance with the principles established in the PTE-2026-0384 Project.

The combined method ensures the validation of the evaluation procedure so that in a first stage, based on experimental results, the entire set of defining parameters of antiseismic devices can be characterized, without performing tests provided for by the standard.

Keywords: tests, seismic isolators, numerical evaluation, combined method

MODAL ANALYSIS OF VIBRATORY COMPACTORS FOR FOUNDATION AND ROADWORKS USING ARTIFICIAL INTELLIGENCE

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Abstract: The paper presents the results of research carried out for two vibratory compaction machines whose dynamic models have three degrees of freedom. The linear viscoelastic connections and the distribution of masses determine the structure and values of the modal parameters and the dynamic response to given harmonic excitations. Thus, for the CVA-5 and CVA 10 vibrating machines, the modal and excitation parametric quantities were established both numerically and experimentally, and are comparatively synthesized in a table for analysis and identification of technologically favorable dynamic regimes. Based on appropriate sensors and the digitalization of work processes, the ease of using artificial intelligence is increased.

Keywords: technological vibrations, resonance regimes, optimal settings, dynamic models

PSYCHOSENSORY EFFECTS ON THE OPERATOR IN THE CAB OF CONSTRUCTION MACHINERY

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Abstract: The paper analyzes the fact that the noise level emitted when using heavy machinery is a risk factor. Thus, machines with a high level of noise, especially inside the control cabin, where the operator's work is carried out, are frequent on the construction site. It has been found that constant, high-intensity noise can have a significant impact on the mental state and general health of workers with pathological effects of a psychological nature.

Thus, it is necessary to highlight the psychological effects of noise on the operators. It also highlights the importance of implementing sound protection and psychological support measures.

Keywords: harmful noise, psychosensory effects, protective measures

SOUNDPROOFING THE CONSTRUCTION MACHINERY OPERATOR'S CABIN WITH SOUND-ABSORBING MATERIALS

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Abstract: Mechanical operators of equipment. Construction equipment operators (excavators, bulldozers, cranes, compactors, etc.) are exposed daily to high noise levels, often above the permissible limit of 85dB(A). In this case, prolonged noise can lead to hearing loss, fatigue, decreased attention, stress and reduced performance.

The purpose of this research is to highlight modern sound-insulating and sound-absorbing solutions applicable in the operator's cabin to reduce the noise level, thus increasing the comfort and safety of workers. In this case, both the cabin geometry and the location of the equipment control were optimized.

Keywords: cabins, soundproofing, equipment, equipment operator

INFLUENCE OF TWO-PHASE FLOW IN BRANCHED PIPING SYSTEMS

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Abstract: This paper presents a CFD simulation of two-phase water–vapor flow through a 90-degree elbow with a nominal diameter of 12 inches and an internal flow diameter of 308 mm.

The aim of this analysis is to assess the influence of hydrodynamic excitation induced by two-phase water–vapor flow through an elbow in the branched piping system, assuming a volume fraction of 10% vapor and 90% liquid. The excitation is quantified through the fluctuating forces exerted by the fluid on the pipe wall and their spectral analysis.

To evaluate the structural response of the pipe under two-phase water–vapor flow, the results obtained from the numerical CFD simulation were used as input data for a one-way fluid–structure interaction (FSI) structural analysis.

Keywords: CFD simulation, hydrodynamic excitation, water–vapor flow, fluid–structure interaction, 90-degree elbow

3D CAD MODELING OF AN ANCHOR WINCH USING SIEMENS NX

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Abstract: The paper details the 3D modeling process of an anchor winch using Siemens NX software. It highlights the essential stages of computer-aided design (CAD), analyzing the main components of the assembly, such as the drum, shaft, and braking system, and their integration into a coherent whole. The project emphasizes the importance of using a CAD environment to optimize design time and increase the accuracy of technical documentation. In the current context of technological development, computer-aided design (CAD) has become a fundamental pillar in modern mechanical engineering. The use of specialized software, such as NX Siemens, offers a complex and efficient platform for creating precise three-dimensional models, functional simulations, and generating the technical documentation necessary for the manufacturing process. This paper aims to model an anchor windlass, an essential mechanism in the equipping of maritime vessels, used for handling anchors and their associated chains. The optimization of such hoisting and load-handling naval systems must account for both structural endurance and the dynamic phenomena specific to marine machinery. The design of this mechanical sub-assembly involves both understanding the operating principles and strength requirements, as well as integrating functionally and economically efficient constructive solutions.

Keywords: computer-aided design, 3D modeling, NX Siemens, anchor winch

THE IMPACT OF SHOCKS TRANSMITTED TO THE HUMAN BODY DURING CONSTRUCTION PROCESSES

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Abstract: The biomechanical effect of the action of perforating hammers (electric, pneumatic or hydraulic) of activities such as breaking concrete, demolishing structures or making holes in masonry is presented. Mechanical vibrations and shocks are transmitted through the hands and arms to the worker's osteoarticular system. It has been found that repeated or prolonged exposure to these demands can have significant effects on the health of the locomotor system.

Keywords: rotary hammers, shocks, harmful vibrations, physiological effects on humans

DYNAMIC BEHAVIOR OF THE AIR VENTILATION AND AIR CONDITIONING DUCTWORK IN TURBULENT AIRFLOW REGIME

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Abstract: *This poster presents the technical aspects of deformation and displacement—under turbulent flow conditions—associated with the air ducts used in ventilation and air conditioning systems; these ducts are the primary components facilitating the transport and distribution of treated air between the HVAC equipment and the served spaces. They play a crucial role in ensuring thermal comfort, indoor air quality, and building energy efficiency.*

Current requirements regarding energy performance, consumption reduction, noise control, and system durability necessitate a complex approach to the design and operation of air distribution systems, as the overall system performance depends heavily on the layout, installation, and operation of these ducts.

The ducts specific to HVAC (Heating, Ventilation, and Air Conditioning) systems form the primary infrastructure for transporting and distributing treated air and the auxiliary fluids required for system operation.

In the current context—characterized by increasingly stringent requirements for energy efficiency, indoor comfort, noise reduction, and environmental protection, these ducts must withstand complex mechanical, aerodynamic, and acoustic demands. A dynamic analysis of the ventilation ductwork system revealed that, for 90° elbows, the excitation frequencies resulting from vortex shedding coincide with—or lie close to—the natural vibration frequencies obtained via modal analysis using Bentley AutoPIPE CONNECT Advanced Edition.

Keywords: *dynamic behavior, vibrations, numerical evaluation, resonance, combined method*

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