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Plate and Panel Structures of Isotropic, Composite and Piezoelectric Materials, Including Sandwich Construction The Behavior of Sandwich Structures of Isotropic and Composite Materials The Behavior of Shells Composed of Isotropic and Composite Materials *The Behavior of Sandwich Structures of Isotropic and Composite Materials* **Response of Isotropic and Composite Materials to Particle Impact The Calculation of Some Physical and Mechanical Properties of Isotropic Composite Materials Isotropic Character of Quasi-Isotropic Lay-ups** *Mechanics of Composite Structural Elements* **Delamination Behavior of Quasi-isotropic Graphite Epoxy Laminates Subjected to Tension and**

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on Composite Materials Analysis (revised) *The Behavior of Structures Composed of Composite Materials* Physical Ultrasonics of Composites **Analyses of Quasi-isotropic Composite Plates Under Quasi-static Point Loads Simulating Low-velocity Impact Phenomena** *Bending Analysis of Isotropic and Laminated Composite Box Beams* **Composite Materials Handbook of Materials Selection** *Experimental Data on Single-bolt Joints in Quasi Isotropic Graphite/polyimide Laminates* **Stress Analysis of Fiber-reinforced Composite Materials** Predicted and Measured Strain Responses of Isotropic Panels to Base Excitation **Electronic Composites Failure Mechanisms in a Quasi-isotropic Ceramic Composite Laminate Under Tensile Fatigue Loading**

Experimental Data on Single-bolt Joints in Quasi Isotropic Graphite/polyimide Laminates Apr 29 2020 The results of an experimental program to determine the bolted-joint strength and failure modes of graphite/polyimide laminates are presented. Sixteen-ply, quasi- isotropic laminates of Celion 6000/PMR-15 and Celion 6000/LARC-160 with a fiber orientation of (O/45/9O/-45)sub 2S were evaluated. Tensile and open-hole specimens were tested at room temperature to establish laminate tensile strength and net tensile strength at an unloaded bolt hole. Double-lap joint specimens with a single 4.83-mm (0.19-in.) diameter bolt torqued to 1.7 N-m (15 lbf-in.) were tested in tension at temperatures of 116 K (-250 F), 297 K (75 F), and 589 K (600 F). The joint ratios of w/d (specimen width to hole diameter) and e/d (edge distance to hole diameter) were varied from 4

to 6 and from 2 to 4, respectively. The effect of joint geometry and temperature on failure mode and joint stresses are shown. Joint stresses calculated at maximum load for each joint geometry and test temperature are reported. Five failure modes were observed for the double-lap joint specimens. For all joint ratios tested, net-tension, bearing, and shear-out stresses decreased with increasing temperature from 116 K (-250 F) to 589 K (600 F). Joint strength in net tension, bearing, and shear-out at 116 K (-250 F), 297 K (75 F), and 589 K (600 F) are given for the Celion 6000/PMR-15 and Celion 6000/LARC-160 laminates.

Response of Isotropic and Composite Materials to Particle Impact

Dec 30 2022 This paper is devoted to determination of damage mechanisms in isotropic and composite materials subjected to particle or projectile impact. The approach consists of three steps: (1) determination of time-dependent surface pressure distribution under an impacting particle, (2) determination of internal stresses in the target caused by the surface pressure, and (3) determination of failure modes in the target caused by the internal stresses. The pressure distribution under an impacting particle is obtained by analytically combining the dynamic solution to the problem of impact of bodies with the static solution for the pressure between two bodies in contact. Having the time-dependent surface pressure, available static analyses are used to obtain the time-dependent triaxial stresses in the targets made of isotropic materials, whereas, for targets made of composite materials the internal stresses are determined using finite-element computer solution.

The internal stresses in targets made of isotropic and composite materials are expressed in terms of target and projectile properties, impact velocity, and impactor shape, and are used to determine the threshold velocities to initiate target damage. Types of target failures considered include tensile cracking, compression/crushing, and subsurface shear failure. Curves are presented that show the relationship between target properties (strength and modulus) and threshold velocity to initiate damage. The results are applied, in an approximate manner, to composites to establish their relative impact resistance. Types of composites considered include: fiberglass, boron-epoxy, and graphite-epoxy. Predictions are made of the threshold velocities to initiate tensile, compressive, and shear failures in the three types of composites and of the order of occurrence of these failure modes.

Plate and Panel Structures of Isotropic, Composite and Piezoelectric Materials, Including Sandwich Construction May 03 2023 Plates and panels are primary components in many structures including space vehicles, aircraft, automobiles, buildings, bridge decks, ships and submarines. The ability to design, analyse, optimise and select the proper materials for these structures is a necessity for structural designers, analysts and researchers. This text consists of four parts. The first deals with plates of isotropic (metallic and polymeric) materials. The second involves composite material plates, including anisotropy and laminate considerations. The third section treats sandwich constructions of various types, and the final section gives an introduction to

plates involving piezoelectric materials, in which the "smart" or "intelligent" materials are used as actuators or sensors. In each section, the formulations encompass plate structures subjected to static loads, dynamic loads, buckling, thermal/moisture environments, and minimum weight structural optimisation. This is a textbook for a graduate course, an undergraduate senior course and a reference. Many homework problems are given in various chapters.

Delamination Behavior of Quasi-isotropic Graphite Epoxy Laminates Subjected to Tension and Torsion Loads Aug 26 2022

Analyses of Submerged, Large-diameter, Circular Cylindrical Shells of Isotropic Or Composite Materials Jan 19 2022

Mechanics of Composite Materials Feb 17 2022 Graduate-level text assembles and interprets contributions to field of composite materials for a comprehensive account of mechanical behavior of heterogeneous media. Subjects include macroscopic stiffness properties and failure characterization. 1979 edition.

The Calculation of Some Physical and Mechanical Properties of Isotropic Composite Materials Nov 28 2022

Analyses of Quasi-isotropic Composite Plates Under Quasi-static Point Loads Simulating Low-velocity Impact Phenomena Sep 02 2020

Buckling of a Sublaminate in a Quasi-isotropic Composite Laminate Apr 21 2022

Handbook of Materials Selection May 30 2020 An innovative resource for materials properties, their evaluation, and industrial applications The Handbook of Materials Selection provides

information and insight that can be employed in any discipline or industry to exploit the full range of materials in use today-metals, plastics, ceramics, and composites. This comprehensive organization of the materials selection process includes analytical approaches to materials selection and extensive information about materials available in the marketplace, sources of properties data, procurement and data management, properties testing procedures and equipment, analysis of failure modes, manufacturing processes and assembly techniques, and applications. Throughout the handbook, an international roster of contributors with a broad range of experience conveys practical knowledge about materials and illustrates in detail how they are used in a wide variety of industries. With more than 100 photographs of equipment and applications, as well as hundreds of graphs, charts, and tables, the Handbook of Materials Selection is a valuable reference for practicing engineers and designers, procurement and data managers, as well as teachers and students.

Mechanics of Composite Structural Elements Sep 26 2022 This second edition of the textbook presents a systematic introduction to the structural mechanics of composite components. The book focusses on modeling and calculation of sandwiches and laminated composites i.e. anisotropic material. The new edition includes an additional chapter covering the latest advances in both research and applications, which are highly relevant for readers. The textbook is written for use not only in engineering curricula of aerospace, civil and mechanical engineering, but also for materials science and applied

mechanics. Furthermore, it addresses practicing engineers and researchers. No prior knowledge of composite materials and structures is required for the understanding of its content. The book is close to classical courses of "Strength of Materials" and "Theory of Beams, Plates and Shells" but it extends the classic content on two topics: the linear elastic material behavior of isotropic and non-isotropic structural elements, and inhomogeneous material properties in the thickness direction. The Finite Element Analysis of laminate and sandwich structures is briefly presented. Many solved examples illustrate the application of the techniques learned.

Mechanical Properties for Thick Fiber Reinforced Composite Materials Having Transversely Isotropic Fibers Dec 18 2021

Modal Interactions in the Dynamic Response of Isotropic and Composite Plates Nov 16 2021

Shear-Modulus Determination of Isotropic and Composite Materials Jun 11 2021 A new test technique that uses split rings to determine the shear modulus of isotropic and composite materials is described. In this test, two concentrated loads that are equal in magnitude but opposite in direction and act normal to the plane of the ring are applied at the point where the ring is split. Pertinent equations which relate the resultant ring deformation to the physical and mechanical properties are given. The out-of-plane deflection is predominantly due to shear deformation, which makes this test an ideal one for shear-modulus determination. Tests are conducted on steel and aluminum rings to demonstrate the accuracy of the new test method. The measured shear moduli are shown to agree within 2

percent of the values reported in the literature. The test then is used to measure the shear moduli of epoxy resin, unidirectional fiber glass composites, bidirectional fiber glass composites, unidirectional boron-epoxy composites, and unidirectional Thornel 40-epoxy composites. The experimental results are compared with theoretically predicted values, and a good agreement is found. Finally, a discussion of existing test method's for shear determination is presented, and the shear moduli obtained by various tests are compared.

Primer on Composite Materials Analysis (revised) Dec 06 2020 A widely used intermediate short text by a composite materials pioneer. Both the quantitative and qualitative aspects of analysis are explained. The presentation is concise and tightly organized.

The Behavior of Shells Composed of Isotropic and Composite Materials Mar 01 2023 Shell structures are used in all phases of structures, from space vehicles to deep submergence hulls, from nuclear reactors to domes on sport arenas and civic buildings. With new materials and manufacturing methods, curved thin walled structures are being used increasingly. This text is a graduate course in the theory of shells. It covers shells of isotropic materials, such as metal alloys and plastics, and shells of composite materials, such as fibre reinforced polymer, metal or ceramic matrix materials. It provides the essential information for an understanding of the underlying theory, and solution of some of the basic problems. It also provides a basis to study the voluminous shell literature. Beyond being primarily a textbook, it is intended also for self study by practising engineers who

would like to learn more about the behaviour of shells. The book has two parts: Part I deals with shells of isotropic materials. In this part the mathematical formulations are introduced involving curvilinear coordinates. The techniques of solutions and resulting behavior is compared to planar thin walled isotropic structures such as plates and beams. Part II then treats the behavior of shells, involving anisotropic composite materials, so widely used today. The analysis involves the complications due to the many elastic constants, effects of transverse shear deformation, thermal thickening and offer effects arising from the properties of composite materials.

Laminar Composites Jun 23 2022 Introduction to Composite Materials; Review of stress, Strain and Material Behavior; Lamina Analysis; Mechanical Test Methods for Lamina Failure Theories; Laminate Analysis; Appendix A, B, C, D; Glossary.

The Bearing Behaviour of Quasi-isotropic Composite Laminates Aug 14 2021

Elastic Constants of Isotropic and Orthotropic Composite Materials from Plate Vibration Test Data May 23 2022 In a separate paper, the first two authors have described a method for deriving the elastic constants of an orthotropic composite material from resonance frequencies and mode shapes obtained in a modal analysis of a completely free plate. In this paper, the method is customized for isotropic materials. This much faster version, which presumes isotropy, is used to predict the elastic constants of square-plate specimens of aluminum and a nearly isotropic glass/polyester sheet molding compound (SMC). The results are compared to those from the full orthotropic method.

The Behavior of Sandwich Structures of Isotropic and Composite Materials Jan 31 2023 The Behavior of Sandwich Structures of Isotropic and Composite Materials presents the mathematics, descriptions, and analytical techniques in the growing field of sandwich structures. From a background in sandwich structures to thermoelastic problems of sandwich structures and sandwich shell theory, the book provides the knowledge needed to analyze, design, and optimize various sandwich structures. As one would expect from a book on sandwich structures, this volume discusses special failure modes such as face wrinkling and core shear instability. Coverage includes not only honeycomb cores, but also foam, web, and truss cores. An important topic in composite structure design, optimization is explored in two chapters on sandwich plates and sandwich shells. The author presents the optimization techniques in closed form and the methods are applicable to material selection and geometric design. The book also contains a set of problems and references at the end of each chapter. This text is ideal for engineers-in-training, as well as practical engineers who desire a comprehensive understanding of sandwich structures technology. Physical Ultrasonics of Composites Oct 04 2020 The objective of this book is to treat the behavior of ultrasonic waves as they interact with layered, anisotropic materials incorporating those structural aspects unique to composite laminates addressing both experimental and modeling methodologies. Anisotropic material interfaces, guided waves, waves in layered media and

laminated plates are treated. The influence of finite-aperture transducers on electronic signals and the field of air-coupled ultrasonics end the work.

Behavior of Isotropic and Composite Plates Subjected to In-plane Shear Loads Oct 16 2021

Computer Networks Feb 05 2021

Properties for Design of Composite Structures Jul 13 2021 PROPERTIES FOR DESIGN OF COMPOSITE STRUCTURES A comprehensive guide to analytical methods and source code to predict the behavior of undamaged and damaged composite materials In Properties for Design of Composite Structures: Theory and Implementation Using Software, distinguished researcher Dr. Neil McCartney delivers a unique and insightful approach to the development of predictive methods for the properties of undamaged and damaged laminated composite materials. The book focuses on presenting compact analytical formulae for several important effective properties—including mechanical, thermal, and electrical—that can be applied to a variety of reinforcement geometries. The author introduces a compact notation that enables an explicit treatment of laminate property determination, including the out-of-plane shear properties required for three-dimensional numerical simulations of structural features using finite and boundary element analyses. There is also a detailed consideration of ply crack closure and a useful study of the interrelationships between the effective thermoelastic constants of damaged laminates. The book also offers: A thorough introduction to the principles and formulae for homogenous materials and applications, including

continuum and fracture concepts for homogeneous materials A comprehensive exploration of the properties of undamaged composites, including undamaged composite materials with multiple phases and the properties of a single undamaged lamina Practical discussions of the properties of damaged composites, including matrix cracking in UD composites and damaged laminates Consideration of effects of delamination, fatigue, and environmentally induced damage In-depth examinations of derivations of key results, including the analysis of bridged cracks and stress transfer mechanics for cross-ply and general symmetric laminates Perfect for composite design engineers in all types of material-supplying industries and manufacturing companies, Properties for Design of Composite Structures: Theory and Implementation Using Software will also earn a place in the libraries of undergraduate and graduate students in engineering, aerospace, and materials departments.

Damage Processes in a Quasi-Isotropic Composite Short Beam Under Three- Point Loading Mar 09 2021 Composite materials have complex failure models that include delamination, fiber debonding and breakage, and matrix microcracking. The influence of these damage models on the failure of the short-beam three-point bend test is investigated for a composite with a quasi-isotropic layup. Failure is found to initiate in a region near the point of application of the load, a location where classical-type analytical descriptions of specimen behavior are unreliable. Furthermore, the locations of failure show little reproducibility. Observed fracture

behavior is explained in terms of the overall stress state of the beam before fracture, and failure is predicted from the stress map, using the maximum strain criterion.
Bending Analysis of Isotropic and Laminated Composite Box Beams Aug 02 2020
The Behavior of Structures Composed of Composite Materials Nov 04 2020 Composite structures and products have developed tremendously since the publication of the first edition of this work in 1986. This new edition of the now classic 1986 text has been written to educate the engineering reader in the various aspects of mechanics for using composite materials in the design and analysis of composite structures and products. Areas dealt with include manufacture, micromechanical properties, structural design, joints and bonding and a much needed introduction to composite design philosophy. Each chapter is concluded by numerous problems suitable for home assignments or examination. A solution guide is available on request from the authors.
Electronic Composites Jan 25 2020 This 2005 book describes the processing, simulation and applications of electronic composites.
Failure Mechanisms in a Quasi-isotropic Ceramic Composite Laminate Under Tensile Fatigue Loading Dec 26 2019
The Behavior of Sandwich Structures of Isotropic and Composite Materials Apr 02 2023 The Behavior of Sandwich Structures of Isotropic and Composite Materials presents the mathematics, descriptions, and analytical techniques in the growing field of sandwich structures. From a background in sandwich structures to thermoelastic

problems of sandwich structures and sandwich shell theory, the book provides the knowledge needed to analyze, design, and optimize various sandwich structures. As one would expect from a book on sandwich structures, this volume discusses special failure modes such as face wrinkling and core shear instability. Coverage includes not only honeycomb cores, but also foam, web, and truss cores. An important topic in composite structure design, optimization is explored in two chapters on sandwich plates and sandwich shells. The author presents the optimization techniques in closed form and the methods are applicable to material selection and geometric design. The book also contains a set of problems and references at the end of each chapter. This text is ideal for engineers-in-training, as well as practical engineers who desire a comprehensive understanding of sandwich structures technology.

Predicted and Measured Strain Responses of Isotropic Panels to Base Excitation Feb 26 2020

Composite Materials Jul 01 2020 In the past ?ve decades considerable attention has been devoted to comp- ite materials. A number of expressions have been suggested by which mac- scopic properties can be predicted when the properties, geometry, and volume concentrations of the constituent components are known. Many expressions are purely empirical or semi-theoretical. Others, however, are theoretically well founded such as the exact results from the following classical boundary studies: Bounds for the elastic moduli of composites made of perfectly coherent homogeneous, isotropic linear elastic phases have been developed by Paul [1] and

Hansen [2] for unrestricted phase geometry and by Hashin and Shtrikman [3] for phase geometries, which cause macroscopic homogeneity and isotropy. The composites dealt with in this book are of the latter type. For two speci?c situations (later referred to), Hashin [4] and Hill [5] derived exact - lutionsforthebulkmodulusofsuchmaterials.Hashinconsideredtheso-called Composite Spheres Assemblage (CSA) consisting of tightly packed congruent composite elements made of spherical particles embedded in concentric - trix shells. Hill considered materials in which both phases have identical shear moduli. In the ?eld of predicting the elastic moduli of homogeneous isotropic c- posite materials in general the exact Hashin and Hill solutions are of th- retical interest mainly. Only a few real composites have the geometry de?ned by Hashin or the sti?ness distribution assumed by Hill. The enormous sign- icance, however, of the Hashin/Hill solutions is that they represent bounds which must not be violated by sti?ness predicted by any new theory claiming to consider geometries in general.

Damage Processes in a Quasi-Isotropic Composite Short Beam Under Three-Point Loading Apr 09 2021 Composite materials have complex failure modes that include delamination, fiber debonding and breakage, and matrix microcracking. In this paper, the influence of these damage modes on the failure of the short-beam three-point bend test is investigated for a composite with a quasi-isotropic layup. Failure is found to initiate in a region near the point of application of the load, a location where classical-type analytical descriptions of specimen behavior are unreliable. Furthermore, the locations of failure show little

reproducibility. Observed fracture behavior is explained in terms of the overall stress state in the beam before fracture, and failure is predicted from the stress map, using the maximum strain criterion.

The Effect of Resin Toughness and Modulus on Compressive Failure Modes of Quasi-isotropic Graphite/epoxy Laminates Jan 07 2021 Compressive failure mechanisms in quasi-isotropic graphite/epoxy laminates were characterized for both unnotched and notched specimens and also following damage by impact. Two types of fibers (Thornel 300 and 700) and four resin systems (Narmco 5208, American Cyanamid BP907, and Union Carbide 4901/MDA and 4901/mPDA) were studied. The widely used T300/5208 served as the baseline composite system. For all material combinations, failure of unnotched specimens was initiated by kinking of fibers in the 0-degree plies. A major difference was observed, however, in the mode of failure propagation after the 0-degree ply failure. In laminates made with Narmco 3208 resin, the 0-degree ply failure was immediately followed by delamination and catastrophic failure of the specimen. In BP907 resin the fiber kinking was well contained without delamination, and still allowed further increase in load. The remaining two resins lay between BP907 and Narmco 5208 in their resistance to delamination. The strength of quasi-isotropic laminates in general increased with increasing resin tensile modulus. The laminates made with Thornel 700 fibers exhibited slightly lower compressive strengths than did the laminates made with Thornel 300 fibers. The notch sensitivity as measured by the hole strength was lowest for the BP907 resin and highest for the 5208 resin. For the materials studied,

however, the type or fiber had no effect on the notch sensitivity. The area of impact damage was smallest for the BP907 resin. The 4901 resins were comparable to the 5208 resin in their impact resistance. Of the two fiber types, the T700 fiber consistently gave smaller damage area. The strength reduction after impact could be explained from the impact damage area and the unnotched strength. (MM). **Isotropic Character of Quasi-Isotropic Lay-ups** Oct 28 2022 Despite the tailorability of laminated fiber composites, the tendency has been to use lay-ups that more closely approximate an isotropic material. These so-called quasi-isotropic lay-ups are used so the structure or component fabricated from them can withstand loads oriented in many directions or perhaps accommodate an unexpected loading. Since there is so much literature associated with predicting the static and dynamic response of isotropic beams, plates, and shells, particularly in table look-up format, the question arises as to the applicability of these tabulated results to members made from quasi-isotropic composite materials. The purposes of this paper are: (1) to indicate the degree of isotropy exhibited by a certain quasi-isotropic sandwich construction, (2) to verify that standard isotropic strength-of-materials formulas can be used to predict the response of these quasi-isotropic components for certain loadings, and (3) to present numerical data for a particular material system. It is felt that even though the results are presented for a sandwich construction, they can be extended to quasi-isotropic lay-ups in general. **Stress Analysis of Fiber-reinforced Composite Materials** Mar 28 2020 Updated and improved, Stress Analysis of Fiber-Reinforced

Composite Materials, Hyer's work remains the definitive introduction to the use of mechanics to understand stresses in composites caused by deformations, loading, and temperature changes. In contrast to a materials science approach, Hyer emphasizes the micromechanics of stress and deformation for composite material analysis. The book provides invaluable analytic tools for students and engineers seeking to understand composite properties and failure limits. A key feature is a series of analytic problems continuing throughout the text, starting from relatively simple problems, which are built up step-by-step with accompanying calculations. The problem series uses the same material properties, so the impact of the elastic and thermal expansion properties for a single-layer of FR material on the stress, strains, elastic properties, thermal expansion and failure stress of cross-ply and angle-ply symmetric and unsymmetric laminates can be evaluated. The book shows how thermally induced stresses and strains due to curing, add to or subtract from those due to applied loads.Another important element, and one unique to this book, is an emphasis on the difference between specifying the applied loads, i.e., force and moment results, often the case in practice, versus specifying strains and curvatures and determining the subsequent stresses and force and moment results. This represents a fundamental distinction in solid mechanics.

Mechanics of Anisotropic Materials Jul 25 2022 The book is focused on constitutive description of mechanical behaviour of engineering materials: both conventional (polycrystalline

homogeneous isotropic or anisotropic metallic materials) and non-conventional (heterogeneous multicomponent anisotropic composite materials). Effective material properties at the macro-level depend on both the material microstructure (originally isotropic or anisotropic) as well as dissipative phenomena occurred on fabrication and consecutive loading phase (hardening) resulting in irreversible microstructure changes (acquired anisotropy). The material symmetry is a background and anisotropy is a core around which the book is formed. In this way a revision of classical rules of enhanced constitutive description of materials is required.

Analysis of Quasi-isotropic Composite Plates Under Quasi-static Point Loads Simulating Low-velocity Impact Phenomena May 11 2021

Analytical and Numerical Buckling and Vibration Investigation of Isotropic and Orthotropic Hyper Composite Materials Structures Sep 14 2021 The analytical solution of the general equation of bucking behaviors and general equation of motion (to evaluated the natural frequency of plate) of isotropic and orthotropic composite plate is investigation. The composite materials studied are isotropic and orthotropic hyper composite materials plate combined from three materials as reinforcement powder, mat or short reinforcement fiber (for isotropic plate) and unidirectional or woven reinforcement fiber (for orthotropic plate) and resin materials. The method using to evaluating the buckling load and natural frequency of orthotropic and isotropic hyper composite plate are theoretical analysis method with derivation the general equation of buckling and

general equation of motion of orthotropic hyper composite, and general equation of buckling and general equation of motion of isotropic hyper composite plate. In addition to, drive the equation of properties of hyper composite materials of plate with effect of powder reinforcement and unidirectional, woven, mat or short fiber and resin materials. The results evaluated are the buckling load and the natural frequency of isotropic and orthotropic hyper composite simply supported plate with different aspect ratio of plate ( ), various volume fraction of reinforcement powder and fiber, and different reinforcement and resin materials types. The theoretical results evaluated of buckling and natural frequency of plate comparison with numerical results evaluated with finite element method by using Ansys program ver. 14, where, the compare between the theoretical and numerical results shown a good agreement with maximum error about (2.7%) with buckling results of isotropic materials plate and maximum error about (1.9%) with buckling results of orthotropic materials plate and maximum error about (3.2%) with natural frequency of orthotropic materials plate and maximum error about (1.8%) with natural frequency of isotropic materials plate. The results evaluated are the buckling load and the natural frequency of simply supported orthotropic and isotropic hyper composite plate combined from powder reinforcement and unidirectional, woven, mat or short fiber and resin materials with different volume fraction and materials types of resin and reinforcement, and different dimensions of plate. The results shown that the adding of reinforcement powder causes increasing of

modulus of elasticity of hyper composite plate, and then, the increasing the volume fraction of reinforcement powder causes increase the natural frequency of isotropic and orthotropic hyper composite plate structure. And, the results shown that the buckling load of plate increasing with increase of the reinforcement powder and the buckling load non effect with the powder reinforcements types. Also, the results shown that the buckling load increases with increase the mat, short, unidirectional or woven reinforcement fiber more than the increases of the buckling load of composite plate with increase of powder reinforcement. And, the buckling load increasing with increase the modulus of elasticity of resin materials types used.Also, the effect of powder reinforcement on the natural frequency of unidirectional and woven hyper composite material beam was studied. The study of natural frequency was evaluated with three methods, the first is theoretical method with driving of the general equation of beam motion with shear deformation and rotary inertia effects, the second is driving of the general equation of motion for single degree of freedom beam, and the third is the numerical method with finite element method by using Ansys program Ver. 14. The study included the powder reinforcement volume fraction effect for hyper composite material beams of the following types: unidirectional, woven hyper composite beams with different volume fractions of fiber.

In-Situ Characterization of Isotropic and Transversely Isotropic Elastic Properties Using Ultrasonic Wave Velocities Mar 21 2022 In this paper, a one-sided, in situ method based on

the time of flight measurement of ultrasonic waves was described. The primary application of this technique was to non-destructively measure the stiffness properties of isotropic and transversely isotropic materials. The method consists of generating and receiving quasi-longitudinal and quasi-shear waves at different through-thickness propagation angles. First, analytical equations were provided to calculate the ultrasonic wave velocities. Then, an inverse method based on non-linear least square technique was used to calculate the stiffness constants using the ultrasonic wave velocities. Sensitivity analysis was performed by randomly perturbing the velocity data, thus observing the effects of perturbations on the calculated stiffness constants. An improved algorithm was proposed and tested to reduce the effects of random errors. Based on the sensitivity analysis, minimum number of angles required to inversely calculate the stiffness constants were suggested for isotropic and transversely isotropic material. The method was experimentally verified on an isotropic 7050-T7451 aluminum with two different thicknesses and a transversely isotropic composite laminate fabricated using 24 plies of CYCOM 977-2 12 k HTA unidirectional carbon fiber reinforced polymer (CFRP) prepregs. The results demonstrated that this technique is able to accurately measure the material properties of isotropic material. As for the transversely isotropic material, this method was able to accurately measure the material properties if the experimental errors can be reduced to less than 1 %.