



Residual Stress Measurement

Tendai Chipanga



Residual Stress Measurement:

Residual Stress Ismail C. Noyan, Jerome B. Cohen, 2013-03-07 *Handbook of Measurement of Residual Stresses* Society for Experimental Mechanics (U.S.), 1996 With contributions from 24 authorities from around the world this handbook provides the most authoritative reference resource available on the impact of residual stresses on mechanical properties of materials and structures You ll find detailed descriptions of a full range of measuring techniques including hole drilling layer removal sectioning X ray diffraction neutron diffraction and ultrasonic methods A variety of case studies which illustrate use of specific techniques are included to facilitate your understanding Design and structural engineers metallurgists and material scientists will find a wealth of valuable information covering recent developments in residual stress measuring techniques with guidelines provided for selecting the right measuring strategy for each specific application and many helpful tips for improving quality control Methods of Residual Stress Measurement ,1965 This manual has been assembled as a ready reference source for the engineer who must measure residual stresses Although the literature has abundant information on the individual methods of residual stress measurement this manual is unique in that most of the useful methods have been selected described classified and compared Methods of measuring residual stress may be classified as mechanical physical or chemical Mechanical methods that are most widely used involve the machining of the part to release the residual stresses These methods are considered in detail and occupy the bulk of this manual Of the physical methods x ray diffraction has many advantages in solving some residual stress problems One of the major advantages is that it is completely nondestructive if only surface residual stresses are desired This method is briefly described and its limitations discussed so that the investigator may choose this method if it fulfills his needs The method and the necessary techniques have been covered in detail in Ref 1 Of the chemical methods the stress corrosion cracking technique seems to be the most useful This cracking is known to be dependent upon the surface tensile stress level At present it is only a qualitative measure of the stress but perhaps at some future date quantitative chemical methods may be developed To make residual stress measurements the engineer must 1Select the most appropriate method 2Completely familiarize himself with the theory behind the method chosen 3Learn the techniques of measurement used by previous investigators Note that the word method is reserved to mean the individual category of stress analysis and that technique applies to the experimental procedure The choice of the method depends to a large extent upon the geometry of the specimen the precision desired the type and location of the stress it is desired to measure and the equipment available The numerous mechanical methods available are classified into four groups These are the parting out method the layer removal method the boring and turning method and the hole drilling method The nonmechanical x ray method is briefly discussed here for comparison Once the method has been selected measurements should not be taken and their values blindly substituted into equations Each term in the expressions relating the deformation to the residual stress should be completely understood and the sign convention used for these terms

should be well known For this reason a derivation for each method has been included with the necessary assumptions and limitations Following a study of these equations it may be decided whether some automatic or computer technique should be used In some instances in which a large number of specimens are to be analyzed the computer technique offers obvious advantages At this point it is also necessary to determine the precision with which the stresses are to be determined This of course can be related directly to the precision used in the measurement of the deformation changes and the original dimensions of the specimen itself The correct choice of the many and varied techniques for measuring dimensional changes used in the determination of residual stress is extremely important if accurate and reproducible data are to be obtained Machining stress introduced in dissecting must not be larger or more significant than the stress that is to be measured The techniques used to remove material are numerous and some of the better currently used techniques are considered The specific techniques associated with any particular method are included and special fixtures and procedures are described and sample calculations are given

Practical Residual Stress Measurement Methods Gary S. Schajer, 2013-09-23 An introductory and intermediate level handbook written in pragmatic style to explain residual stresses and to provide straightforward guidance about practical measurement methods Residual stresses play major roles in engineering structures with highly beneficial effects when designed well and catastrophic effects when ignored With ever increasing concern for product performance and reliability there is an urgent need for a renewed assessment of traditional and modern measurement techniques Success critically depends on being able to make the most practical and effective choice of measurement method for a given application Practical Residual Stress Measurement Methods provides the reader with the information needed to understand key residual stress concepts and to make informed technical decisions about optimal choice of measurement technique Each chapter written by invited specialists follows a focused and pragmatic format with subsections describing the measurement principle residual stress evaluation practical measurement procedures example applications references and further reading The chapter authors represent both international academia and industry Each of them brings to their writing substantial hands on experience and expertise in their chosen field Fully illustrated throughout the book provides a much needed practical approach to residual stress measurements The material presented is essential reading for industrial practitioners academic researchers and interested students Key features Presents an overview of the principal residual stress measurement methods both destructive and non destructive with coverage of new techniques and modern enhancements of established techniques Includes stand alone chapters each with its own figures tables and list of references and written by an invited team of international specialists

Residual Stress Measurement and the Slitting Method Weili Cheng, Iain Finnie, 2007-02-24 This book provides complete coverage of the slitting method It details new results in analysis computation and estimation and discusses different roles of residual stresses from the fracture mechanics perspective It provides detailed formulations and examples of compliance functions weighted least squares fit and

convergence test in stress estimation and computer programs to facilitate the implementation of the slitting method

Residual Stresses 2016 Thomas M. Holden, Ondrej Muránsky, Lyndon Edwards, 2017-03-15 This book presents the proceedings of the International Conference on Residual Stresses 10 and is devoted to the prediction modelling evaluation control and application of residual stresses in engineering materials New developments on stress measurement techniques on modelling and prediction of residual stresses and on progress made in the fundamental understanding of the relation between the state of residual stress and the material properties are highlighted The proceedings offer an overview of the current understanding of the role of residual stresses in materials used in wide ranging application areas **New**

Challenges in Residual Stress Measurements and Evaluation Caterina Casavola, Claudia Barile, Vincenzo Moramarco, Giovanni Pappaletta, 2020-07-22 Residual stresses RS are stresses present inside materials even in the absence of any applied load They are of capital importance because they can impact greatly on the mechanical strength of the material on its dimensional correspondence to design specifications as well as on the fatigue life of the part RS measurement and evaluation is currently an important research topic where a lot of challenges still need to be addressed This book aims to provide the reader with an overview of the principal novelties in this field including current limitations and potential future developments Both radically new experimental approaches as well as recent evolutions of consolidated ones will be presented along with the latest novelties in the area of numerical residual stress evaluation Residual Stress Measurement by X-ray Diffraction-SAE HS-784 SAE Iron and Steel Technical Committee, 2003 *Residual Stress Measurements* American Society for Metals, R. G. Treuting, 1952 **Residual Stress Measurement Using Cross-slitting and ESPI.**, 2002 Residual stresses are locked in within a material and exist without any external loads Such stresses are developed during most common manufacturing processes for example welding cold working and grinding These hidden stresses can be quite large and can have profound effects on engineering properties notably fatigue life and dimensional stability To obtain reliable and accurate residual stress measurements for uniform and non uniform stress states a novel and practical method using crossing slitting and ESPI is presented here Cross slitting releases all three in plane stress components and leaves nearby deformation areas intact The ESPI Electronic Speckle Pattern Interferometry technique gives an attractive tool for practical use because measurements provide a large quantity of useful data require little initial setup and can be completed rapidly and at low per measurement cost A new ESPI setup consisting of shutter and double mirror device is designed to achieve dual axis measurements to balance the measurement sensitivities of all in plane stress components To evaluate data quality a pixel quality control and correction procedure is also applied This helps to locate bad data pixels and provides opportunities to correct them The measurement results show that this procedure plays an important role for the success of residual stress evaluation Based on the observed displacement data and finite element calculated calibration data an inverse computation method is developed to recover the residual stresses in a material for both uniform and non uniform cases By combining

cross slitting and ESPI more reliable results for the three in plane residual stress components can be obtained

Hole-Drilling Method for Measuring Residual Stresses Gary S. Schajer, Philip S. Whitehead, 2018-01-22 This book describes the theory and practice of the Hole Drilling Method for measuring residual stresses in engineering components. Such measurements are important because residual stresses have a hidden character because they exist locked in within a material independent of any external load. These stresses are typically created during component manufacture for example during welding, casting or forming. Because of their hidden nature, residual stresses are difficult to measure and consequently are often ignored. However, they directly add to loading stresses and can cause catastrophic failure if not properly included during engineering design. Thus, there is an urgent need to be able to identify and measure residual stresses conveniently and reliably. The Hole Drilling Method provides an adaptable and well-proven method for measuring residual stresses in a wide range of materials and component types. It is convenient to use and gives reliable results. Because of the hidden nature of residual stresses, the measurement method must necessarily be indirect; thus, additional care and conceptual understanding are necessary to achieve successful results. This book provides a practical introduction to the Hole Drilling Method, starting from its historical roots and going on to focus on its modern practice. The various chapters describe the nature of residual stresses, the principle of hole drilling measurements, procedures and guidance on how to make successful measurements, and effective mathematical procedures for stress computation and analysis. The book is intended for practitioners who need to make residual stress measurements either occasionally or routinely for practicing engineers, for researchers, and for graduate engineering and science students.

Residual Stress Measurement by X-Ray Diffraction SAE Iron and Steel Technical Committee, Society of Automotive Engineers. Fatigue Design and Evaluation Committee, 1976-01-01

New Methods of Measurement of Residual Stress R. F. Brodrick, 1954

Determination of the Accuracy of Residual Stress Measurement Methods Tendai Chipanga, 2010-12 This book appeals to an audience in the engineering field, specifically Mechanical Engineering. Professional design engineers will find this work useful in the estimation of the magnitudes of residual stresses in components and correctly account for them when determining factors of safety. Destructive and non-destructive technicians will find it helpful in the condition monitoring of plant and equipment, while a basis for researchers is laid to pursue further work. The book focuses on the measurements of displacements, time of flight, ultrasonic velocity, and strains in steel specimens, which subsequently prompts the calculation of stresses. The following methods are covered: Hole Drilling, Ultrasonic Debro 30 System, and Digital Shearography. Emphasis is laid on the experimental procedures and the analysis of the results thereof. A novel technique of quantifying residual stresses using shearograms obtained from Digital Shearography experimental data is proposed. This, however, warrants further investigations that require independent verification stress measurement methods.

Practical Residual Stress Measurement Methods Gary S. Schajer, 2013-08-01 An introductory and intermediate level handbook written in pragmatic style to explain residual stresses and to provide

straightforward guidance about practical measurement methods Residual stresses play major roles in engineering structures with highly beneficial effects when designed well and catastrophic effects when ignored With ever increasing concern for product performance and reliability there is an urgent need for a renewed assessment of traditional and modern measurement techniques Success critically depends on being able to make the most practical and effective choice of measurement method for a given application Practical Residual Stress Measurement Methods provides the reader with the information needed to understand key residual stress concepts and to make informed technical decisions about optimal choice of measurement technique Each chapter written by invited specialists follows a focused and pragmatic format with subsections describing the measurement principle residual stress evaluation practical measurement procedures example applications references and further reading The chapter authors represent both international academia and industry Each of them brings to their writing substantial hands on experience and expertise in their chosen field Fully illustrated throughout the book provides a much needed practical approach to residual stress measurements The material presented is essential reading for industrial practitioners academic researchers and interested students Key features Presents an overview of the principal residual stress measurement methods both destructive and non destructive with coverage of new techniques and modern enhancements of established techniques Includes stand alone chapters each with its own figures tables and list of references and written by an invited team of international specialists

Residual Stress Measurement by X-ray Diffraction Yang-Ming Chang, 1972

Residual Stresses 2018 Marc Seefeldt, 2018-10-10 The European Conference on Residual Stresses ECRS series is the leading European forum for scientific exchange on internal and residual stresses in materials It addresses both academic and industrial experts and covers a broad gamut of stress related topics from instrumentation via experimental and modelling methodology up to stress problems in specific processes such as welding or shot peening and their impact on materials properties Chapters Diffraction Methods Mechanical Relaxation Methods Acoustic and Electromagnetic Methods Composites Nano and Microstructures Films Coatings and Oxides Cold Working and Machining Heat Treatments and Phase Transformations Welding Fatigue and Fracture Stresses in Additive Manufacturing

Standards for Residual Stress Measurement L. Mordfin, 1982 It has been long appreciated that residual stresses can exert significant influences on fatigue and fracture behavior but only recently have analytical models been developed which enable the influences to be quantified These new capabilities have fostered increased demands for residual stress measurements and these in turn have revealed that the reliability and the reproducibility of such measurements are often less than adequate The need for standards for residual stress measurements is now recognized as being urgent Few standards presently exist and they do not provide the required levels of measurement reproducibility

Residual Stress Measurement by X-ray Diffraction-SAE J784a SAE Iron and Steel Technical Committee, 1971

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