Analysis Of Welding Residual Stress And Distortion In

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Residual Stress Analysis on Welded Joints by Means of Numerical Simulation and Experiments Springer Science & Business Media
These recommendations present general methods for the assessment of fatigue damage in welded components, which may affect the limit states of a structure, such as ultimate limit state and serviceability limited state. Fatigue resistance data is given for welded components made of wrought or extruded products of ferritic/pearlitic or banitic structural steels up to fy = 700 Mpa and of aluminium alloys commonly used for welded structures.
Fatigue Assessment of Welded Joints by Local Approaches CRC Press
A finite element model that is capable of simulating the thermo-mechanical welding process was developed by using full thermal-elasto-plastic computational analysis and validated by comparison with experimental data. It shows that distortions predicted by the finite element model agree well with measured data from previous literature and that the numerically obtained residual stress distribution is compared and agreed by both ANSYS and VrWeld software. After that, a simple method for predicting butt-welding residual stresses based on force and moment equilibrium was derived in this section. The results calculated from this simple method were a good match with the FE results. Then the author performed detailed analysis for the distribution of transverse and longitudinal residual stresses of 2D butt welding process by using 3D elements, which illustrated how the butt-welding residual stresses were distributed and accumulated during the welding process and how the boundary conditions affect the final results. A detailed parametric study for butt welding residual stresses based on 2D butt-welding by using 3D element was demonstrated. The factors carried out in the parametric study involved cut-off temperature effect, welding power effect, welding velocity effect, plate length effect and plate width effect. Lastly, the author also presented a simulation and an optimization of welding sequences for residual stress and distortion of a typical, fatigue sensitive, ship's side shell connection detail under different welding sequences.
Residual Stresses 2018 Materials Research Forum LLC
This book describes the fundamentals of residual stresses in friction stir welding and reviews the data reported for various materials. Residual stresses produced during manufacturing processes lead to distortion of structures. It is critical to understand and mitigate residual stresses. From the onset of friction stir welding, claims have been made about the lower magnitude of residual stresses. The lower residual stresses are partly due to lower peak temperature and shorter time at temperature during friction stir welding. A review of residual stresses that result from the friction stir process and strategies to mitigate it have been presented. Friction stir welding can be combined with additional in-situ and ex-situ manufacturing steps to lower the final residual stresses. Modeling of residual stresses highlights the relationship between clamping constraint and development of distortion. For many applications, management of residual stresses can be critical for qualification of component/structure. Reviews magnitude of residual stresses in various metals and alloys Discusses mitigation strategies for residual stresses during friction stir welding Covers fundamental origin of residual stresses and distortion
Fatigue and Fracture of Weldments Butterworth-Heinemann
This report introduces definitions of the terminology relevant to stress determination for fatigue analysis of welded components. The various stress concentrations, stress categories and fatigue analysis methods are defined. Fatigue analysis methods considered are nominal stress, hot spot stress, notch stress, notch strain and fracture mechanics approaches. The report also contains comprehensive recommendations concerning the application of finite element methods and experimental methods for stress determination. It is intended for fatigue design of common welded structures, such as cranes, excavators, vehicle frames, bridges, ship hulls, offshore structures etc. fabricated from materials at least 3mm thick. In general, attention is focused on weld details which give rise to fatigue cracking from the surface, notably from the weld toe.
Residual Stress Analysis on Welded Joints by Means of Numerical Simulation and Experiments John Wiley & Sons
Welded High Strength Steel Structures Understand the impact of fatigue on high strength steel joints with this comprehensive overview High strength steels are highly sought after for industrial and engineering applications ranging from armored vehicles to welded engineering components built to withstand considerable stress. The mechanical properties of welded joints made from high strength steel are integrally linked to the specific welding process, which can have an enormous impact on fatigue performance. Welded High Strength Steel Structures: Welding Effects and Fatigue Performance provides a comprehensive analysis of high strength steel joints and the ramifications of the welding process. It guides readers through the process of performing thermal analysis of high strength steel structures and evaluate fatigue performance in the face of residual stress. The result

is a volume with innumerable use cases in engineering and manufacture. Welded High Strength Steel Structures readers will also find: An author with decades of experience in research and engineering Numerous studies of various classes of high strength steel joints Studies on tubular structures for welding residual stress Welded High Strength Steel Structures is a must-own for welding specialists, materials scientists, mechanical engineers, and researchers or industry professionals in related fields.

Minimization of Welding Distortion and Buckling Elsevier

Almost all welding technology depends upon the use of concentrated energy sources to fuse or soften the material locally at the joint, before such energy can be diffused or dispersed elsewhere. Although comprehensive treatments of transient heat flow as a controlling influence have been developed progressively and published over the past forty years, the task of uniting the results compactly within a textbook has become increasingly formidable. With the comparative scarcity of such works, welding engineers have been denied the full use of powerful design analysis tools. During the past decade Dr Radaj has prepared to fulfil this need, working from a rich experience as pioneer researcher and teacher, co-operator with Professor Argyris at Stuttgart University in developing the finite element method for stress analysis of aircraft and power plant structures, and more recently as expert consultant on these and automotive structures at Daimler Benz. His book appeared in 1988 in the German language, and this updated English language edition will significantly increase the availability of the work.

Fatigue of Welded Structures John Wiley & Sons

One of the most widely used permanent joining processes is welding. Welding results in a very complex thermal cycle which results in irreversible elastic-plastic deformation and residual stresses in and around fusion zone and heat affected zone (HAZ). Residual stresses may be an advantage or disadvantage in structural components depending on their nature and magnitude. Due to these residual stresses produced in and around the weld zone the strength and life of the component is reduced. In present study a commercially available finite element code was used to model and analyze a three dimensional model of the butt welded joint of two AISI 304 stainless steel plate used for manufacturing sugar hoppers. Butt welding simulations were performed by four different welding techniques - submerged arc welding (SAW), manual metal arc welding (MMAW), gas metal arc welding (MIG) and gas tungsten arc welding (TIG). Analysis of butt welded joint showed that butt welds produced by MIG resulted in lowest value of residual stress in plates. Critical analysis of butt welded joint by MIG and TIG showed that by increasing plate thickness, the residual stresses also increases.

Design and Analysis of Fatigue Resistant Welded Structures Springer

Includes papers on the effects of residual stress on materials properties. Measurement methods and techniques are covered in a number of papers that describe applications of X-ray diffraction, Barkhausen noise, ultrasonic velocity and neutron diffraction. Prediction of residual stresses described include applications to metal welding, forging and forming as well as ceramic matric composites and those developed by manufacturing processes.

FEA of Residual Stresses in Butt Welding of Two Stainless Steel Plates John Wiley & Sons

Avoiding or controlling fatigue damage is a major issue in the design and inspection of welded structures subjected to dynamic loading. Life predictions are usually used for safe life analysis, i.e. for verifying that it is very unlikely that fatigue damage will occur during the target service life of a structure. Damage tolerance analysis is used for predicting the behavior of a fatigue crack and for planning of in-service scheduled inspections. It should be a high probability that any cracks appearing are detected and repaired before they become critical. In both safe life analysis and the damage tolerance analysis there may be large uncertainties involved that have to be treated in a logical and consistent manner by stochastic modeling. This book focuses on fatigue life predictions and damage tolerance analysis of welded joints and is divided into three parts. The first part outlines the common practice used for safe life and damage tolerance analysis with reference to rules and regulations. The second part emphasises stochastic modeling and decision-making under uncertainty, while the final part is devoted to recent advances within fatigue research on welded joints. Industrial examples that are included are mainly dealing with offshore steel structures. Spreadsheets which accompany the book give the reader the possibility for hands-on experience of fatigue life predictions, crack growth analysis and inspection planning. As such, these different areas will be of use to engineers and researchers.

Practical Residual Stress Measurement Methods ASTM International

The ability to quantify residual stresses induced by welding processes through experimentation or numerical simulation has become, today more than ever, of strategic importance in the context of their application to advanced design. This is an ongoing challenge that commenced many years ago. Recent design criteria endeavour to quantify the effect of residual stresses on fatigue strength of welded joints to allow a more efficient use of materials and a greater reliability of welded structures. The aim of the present book is contributing to these aspects of design through a collection of case-studies that illustrate both standard and advanced experimental and numerical methodologies used to assess the residual stress field in welded joints. The work is intended to be of assistance to designers, industrial engineers and academics who want to deepen their knowledge of this challenging topic.

State of the Art Review CUP Archive

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.

Fatigue Design of Welded Joints and Components Elsevier

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.

Fatigue Testing of Weldments BoD – Books on Demand

The ability to quantify residual stresses induced by welding processes through experimentation or numerical simulation has become, today more than ever, of strategic importance in the context of their application to advanced design. This is an ongoing challenge that commenced many years ago. Recent design criteria endeavour to quantify the effect of residual stresses on fatigue strength of welded joints to allow a more efficient use of materials and a greater reliability of welded structures. The aim of the present book is contributing to these aspects of design through a collection of case-studies that illustrate both standard and advanced experimental and numerical methodologies used to assess the residual stress field in welded joints. The work is intended to be of assistance to designers, industrial engineers and academics who want to deepen their knowledge of this challenging topic.

Residual Stress Effects in Fatigue ASTM International

The failure of any welded joint is at best inconvenient and at worst can lead to catastrophic accidents. Fracture and fatigue of welded joints and structures analyses the processes and causes of fracture and fatigue, focusing on how the failure of welded joints and structures can be predicted and minimised in the design process. Part one concentrates on analysing fracture of welded joints and structures, with chapters on constraint-based fracture mechanics for predicting joint failure, fracture assessment methods and the use of fracture mechanics in the fatigue analysis of welded joints. In part two, the emphasis shifts to fatigue, and chapters focus on a variety of aspects of fatigue analysis including assessment of local stresses in welded joints, fatigue design rules for welded structures, k-nodes for offshore structures and modelling residual stresses in predicting the service life of structures. With its distinguished editor and international team of contributors, Fracture and fatigue of welded joints and structures is an essential reference for mechanical, structural and welding engineers, as well as those in the academic sector with a research interest in the field. Analyses the processes and causes of fracture and fatigue, focusing predicting and minimising the failure of welded joints in the design process Assesses the fracture of welded joints and structure featuring constraint-based fracture mechanics for predicting joint failure Explores specific considerations in fatigue analysis including the assessment of local stresses in welded joints and fatigue design rules for welded structures

Computational Welding Mechanics BoD – Books on Demand

Welding processes handbookis an introductory guide to all of the main welding processes. It is specifically designed for students on EWF courses and newcomers to welding and is suitable as a textbook for European welding courses in accordance with guidelines from the European Welding Federation. Welding processes and equipment necessary for each process are described so that they can be applied to all instruction levels required by the EWF and the important areas of welded joint design, quality assurance and costing are also covered in detail.

Welding for Challenging Environments Woodhead Publishing

As a fabrication technology, welding presents a number of technical challenges to the designer, manufacturer, and end-user of the welded structures. Both weld residual stress and distortion can significantly impair the performance and reliability of the welded structures. They must be properly dealt with during design, fabrication, and in-service use of the welded structures. There have been many significant and exciting developments on the subject in the past ten to fifteen years. Measurement techniques have been improved significantly. More importantly, the development of computational welding mechanics methods has been phenomenal. The progresses in the last decade or so have not only greatly expanded our fundamental understanding of the processes and mechanisms of residual stress and distortion during welding, but also have provided powerful tools to quantitatively determine the detailed residual stress and distortion information for a given welded structure. New techniques for effective residual stress and distortion mitigations and controls have also been applied in different industry sectors. Processes and Mechanisms of Welding Residual Stress and Distortion provides a comprehensive summary on the developments in the subject. It outlines theoretical treatments on heat transfer, solid mechanics and materials behavior that are essential for understanding and determining the welding residual stress and distortion. The approaches for computational methods and analysis methodology are described so that non specialists can follow them. There are chapters devoted to the discussion of various techniques for control and mitigation of residual stress and distortion, and residual stress and distortion results for various typical welded structures are provided. The second half of the book looks at case studies and practical solutions and provides insights into the techniques, challenges, limitations and future trends of each application. This book will not only be useful for advanced analysis of the subject, but also provide sufficient examples and practical solutions for welding engineers. With a panel of leading experts this authoritative book will be a valuable resource for welding engineers and designers as well as academics working in the fields of structural and mechanical engineering.

Fracture and Fatigue of Welded Joints and Structures KIT Scientific Publishing

Analysis of Welded Structures: Residual Stresses, Distortion, and their Consequences encompasses several topics related to design and fabrication of welded structures, particularly residual stresses and distortion, as well as their consequences. This book first introduces the subject by presenting the advantages and disadvantages of welded structures, as well as the historical overview of the topic and predicted trends. Then, this text considers residual stresses, heat flow, distortion, fracture toughness, and brittle and fatigue fractures of weldments. This selection concludes by discussing the effects of distortion and residual stresses on buckling strength of welded structures and effects of weld defects on service behavior. This book also provides supplementary discussions on some related and selected subjects. This text will be invaluable to metallurgists, welders, and students of metallurgy and welding.

Computational Welding Mechanics for Engineering Application Materials Research Forum LLC

Research goal of the present monograph is the establishment of an efficient engineering approach, which will include straightforward but accurate simulation models, in order to estimate the residual stress fields of welded joints introduced during welding and their post-weld treatment with High Frequency Hammer Peening. The present subject lies on the intersection of structural engineering, material science and computational mechanics.

Estimation of Residual Stresses in Marine Structures Woodhead Publishing

Computational Welding Mechanics (CWM) provides readers with a complete introduction to the

principles and applications of computational welding including coverage of the methods engineers and designers are using in computational welding mechanics to predict distortion and residual stress in welded structures, thereby creating safer, more reliable and lower cost structures. Drawing upon years of practical experience and the study of computational welding mechanics the authors instruct the reader how to: - understand and interpret computer simulation and virtual welding techniques including an in depth analysis of heat flow during welding, microstructure evolution and distortion analysis and fracture of welded structures, - relate CWM to the processes of design, build, inspect, regulate, operate and maintain welded structures, - apply computational welding mechanics to industries such as ship building, natural gas and automobile manufacturing. Ideally suited for practicing engineers and engineering students, Computational Welding Mechanics is a must-have book for understanding welded structures and recent technological advances in welding, and it provides a unified summary of recent research results contributed by other researchers.

Practical Applications of Residual Stress Technology Elsevier

Welding for Challenging Environments documents the proceedings of the International Conference on Welding for Challenging Environments held in Ontario, Canada on October 15-17, 1985. This compilation provides a unique reference to the state of technological development, research, and application of welded fabrications in challenging environments. This book discusses the developments in pulsed gas metal arc welding; pulsed FM-GMA welding; and narrow gap welding of pressure vessels. The fracture toughness considerations for offshore structures; microcomputer method for predicting preheat temperatures; and submerged arc welding of high yield strength steel are also elaborated. This text likewise covers the influence of nitrogen content on deposited weld metal notch toughness gas-metal-slag interactions of binary fluxes containing CaF2 and evaluation of susceptibility of welds made with a stable austenitic welding wire to hot cracking. This publication is a good source for welders and metallurgists, as well as students interested in welded fabrications in challenging environments.