Random vibration analysis and fatigue life evaluation of auxiliary heater bracket

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Abstract: CAE has been an important tool in the process of automotive product development. Chassis mounted components on the truck are subjected to random excitations from the road during their life cycle. While designing the components, it should be ensured that the component should sustain the random vibration loads for the life cycle of the vehicle. These random vibration loads are also responsible for the fatigue failure of the component. The object of this study was to predict the fatigue life cycle of a chassis mounted component, an Auxiliary Heater Bracket concept which was, in actual scenario, subjected to random vibration excitations from the road. The weld fatigue life was also calculated in this exercise. It was estimate that the bracket concept was not able to sustain infinite life in the 1σ level of confidence. A redesign of the Auxiliary Heater Bracket was suggested to achieve infinite fatigue life. There is a requirement about the bracket that it must endure infinite life in 1σ and 2σ level of confidence. Infinite life cycle in the FEA simulation was achieved for the modified bracket. Random Vibration Analysis was performed on the bracket model in Abaqus and response was calculated up to 130 Hz. RMS stresses were used for the fatigue life cycle calculations and the fatigue life cycle was determined from the Basquin's relation. Abaqus was very helpful in completing this life cycle simulation. Python scripting was used to post process huge amount of data in generating the RMS stresses.

Keywords: Fatigue, Auxiliary heater bracket, Abaqus, Random Vibration Fatigue, PSD, Weld Fatigue, Basquin's Relation, PYTHON scripting, CAE

1. Introduction

The auxiliary heater bracket mounted on the chassis cross member along with several other components on truck is subjected to loads due to the engine operations and vehicle road conditions. These loads are typically random in nature. It is very important to predict the fatigue life of the components for getting an optimized design for these components. This application forms a specialized analysis domain which can be referred as random vibration fatigue analysis. In a compressed design cycle, most of the FEA is done on the various engine and chassis mounted components using simplified load representations. This is in the form of applying fixed inertia loads on the components as per relevant industry standards and calculating the natural frequencies. In this paper, we may observe that with the help of Abaqus, the loads and boundary conditions were simulated close to the real environment. This was achieved in a very small time frame, thus not impacting the design life cycle.

Random Vibration Analysis And Fatigue Life Evaluation

China Society of Automotive Engineers

Random Vibration Analysis And Fatigue Life Evaluation:

Non-Gaussian Random Vibration Fatigue Analysis and Accelerated Test Yu Jiang,Junyong Tao,Xun Chen,2021-09-15 This book discusses the theory method and application of non Gaussian random vibration fatigue analysis and test The main contents include statistical analysis method of non Gaussian random vibration modeling and simulation of non Gaussian non stationary random vibration response analysis under non Gaussian base excitation non Gaussian random vibration fatigue life analysis fatigue reliability evaluation of structural components under Gaussian non Gaussian random loadings non Gaussian random vibration accelerated test method and application cases From this book the readers can not only learn how to reproduce the non Gaussian vibration environment actually experienced by the product but also know how to evaluate the fatigue life and reliability of the structure under non Gaussian random excitation **Achieving System Reliability Growth Through Robust Design and Test** David Nicholls,Paul Lein,2011-06 Historically the reliability growth process has been thought of and treated as a reactive approach to growing reliability based on failures discovered during testing or most unfortunately once a system product has been delivered to a customer As a result many reliability growth models are predicated on starting the reliability growth process at test time zero with some initial level of reliability usually in the context of a time based measure such as Mean Time Between Failure MTBF Time zero represents the start of testing and the initial reliability of the test item is based on its inherent design The problem with this approach still predominant today is that it ignores opportunities to grow reliability during the design of a system or product i e opportunities to go into reliability growth testing with a higher initial inherent reliability at time zero In addition to the traditional approaches to reliability growth during test this book explores the activities and opportunities that can be leveraged to promote and achieve reliability growth during the design phase of the overall system life cycle The ability to do so as part of an integrated proactive design environment has significant implications for developing and delivering reliable items quickly on time and within budget This book offers new definitions of how failures can be characterized and how those new definitions can be used to develop metrics that will quantify how effective a Design for Reliability DFR process is in 1 identifying failure modes and 2 mitigating their root failure causes Reliability growth can only occur in the presence of both elements The Shock and Vibration Bulletin ,1982 **Scientific and Technical Aerospace Reports** ,1994 Mechanical Vibration and Shock Analysis, Fatigue Damage Christian Lalanne,2014-05-12 Fatigue damage in a system with one degree of freedom is one of the two criteria applied when comparing the severity of vibratory environments The same criterion is also used for a specification representing the effects produced by the set of vibrations imposed in a real environment In this volume which is devoted to the calculation of fatigue damage Christian Lalanne explores the hypotheses adopted to describe the behavior of material affected by fatigue and the laws of fatigue accumulation The author also considers the methods for counting response peaks which are used to establish the histogram when it is not possible to use the probability density of the peaks obtained with a

Gaussian signal The expressions for mean damage and its standard deviation are established and other hypotheses are tested

Proceedings of the International Conference on Industrial and Manufacturing Systems (CIMS-2020) Ravi Pratap Singh,Dr Mohit Tyagi,Dilbagh Panchal,J. Paulo Davim,2021-07-24 In order to deal with the societal challenges novel technology plays an important role For the advancement of technology Department of Industrial and Production Engineering under the aegis of NIT Jalandhar is organizing an International Conference on Industrial and Manufacturing Systems CIMS 2020 from 26th 28th June 2020 The present conference aims at providing a leading forum for sharing original research contributions and real world developments in the field of Industrial and Manufacturing Systems so as to contribute its share for technological advancements This volume encloses various manuscripts having its roots in the core of industrial and production engineering Globalization provides all around development and this development is impossible without technological contributions CIMS 2020 gathered the spirits of various academicians researchers scientists and practitioners answering the vivid issues related to optimisation in the various problems of industrial and manufacturing systems **Structural Dynamics of Electronic and Photonic Systems** Ephraim Suhir,T. X. Yu,David S. Steinberg,2011-04-04 The proposed book will offer comprehensive and versatile methodologies and recommendations on how to determine dynamic characteristics of typical micro and opto electronic structural elements printed circuit boards solder joints heavy devices etc and how to design a viable and reliable structure that would be able to withstand high level dynamic loading Particular attention will be given to portable devices and systems designed for operation in harsh environments such as automotive aerospace military etc In depth discussion from a mechanical engineer s viewpoint will be conducted to the key components level as well as the whole device level Both theoretical analytical and computer aided and experimental methods of analysis will be addressed The authors will identify how the failure control parameters e g displacement strain and stress of the vulnerable components may be affected by the external vibration or shock loading as well as by the internal parameters of the infrastructure of the device Guidelines for material selection effective protection and test methods will be developed for engineering practice *Dynamic Environments Testing, Volume 7* Julie Harvie,2025-08-07 Dynamic Environments Testing Volume 7 Proceedings of the 41st IMAC A Conference and Exposition on Structural Dynamics 2023 the seventh volume of ten from the Conference brings together contributions to this important area of research and engineering The collection presents early findings and case studies on fundamental and applied aspects Dynamic Environments Testing including papers on Vibration Testing Shock Testing Multi Axis Shaker Testing Test Fixture Design Dynamic Environment Definition Specifications for Acceptance Testing

Probabilistic fracture mechanics and reliability J.W. Provan,2013-04-17 With the advent of the 80 s there has been an increasing need for analytic and numerical techniques based on a thorough understanding of microstructural processes that express in a manner suitable for practicing engineers the reliability of components and structures that are being subjected to degradation situations Such situations fall within the framework offracture mechanics fatigue corrosion fatigue and pitting

corrosion Luckily such techniques are now being developed and it was felt timely to combine in one volume reports by the leaders in this field who are currently making great strides towards solving these problems Hence the idea of this monograph was born and I am pleased to be associated both with it and the contributors whose chapters are included in this volume A very large part of the credit for this monograph must go to the authors who have taken time out from their busy schedules to prepare their submissions They have all worked diligently over the last few months in order to get their manuscripts to me on time and I sincerely thank them for their help throughout the preparation of this volume *International Conference on Structural Safety and Reliability* Alfred M. Freudenthal,2014-05-17 International Conference on Structural Safety and Reliability documents the proceedings of a conference of the same name which focuses mainly on the integration of all aspects of structural design load analysis stability and strength analysis and stress and deformation analysis by the safety and reliability analysis of the structure of necessity This text is divided into five sessions reflecting the manner each topic is presented in the symposium The general aspects of structural reliability are first presented and then the methods of safety and reliability analysis and the Bayesian statistical decision theory and reliability based design are examined This book then considers the problems regarding the extreme values of stochastic processes as well as other statistical theories of extremes A part in this text is devoted to the random excitation of structures The last two parts examine the development of modern aircraft design and structure as well as special reliability problems to evaluate and apply the theories examined This book will be valuable to engineering students and engineers interested in structural safety and reliability **Multi-Scale Reliability and Serviceability Assessment of In-Service Long-Span Bridges** Naiwei Lu,Mohammad Noori,2018-05-08 With the development in global economic and transportation engineering the traffic loads on brides have been growing steadily which become potential safety hazards for existing bridges In particular long span suspension bridges support heavy traffic volumes and simultaneous truck loads on the bridge deck and thus the safety and serviceability of the bridge deserves investigation In this book a multiscale reliability method is presented for the safety assessment of long span bridges The multiscale failure condition of stiffness girders is the first passage criteria for the large scale model and the fatigue damage criteria for the small scale model It is the objective of this book to provide a more in depth understanding of the vehicle bridge interaction from the random vibration perspective This book is suitable for adoption as a text book or a reference book in an advanced structural reliability analysis course Furthermore this book also provides a theoretical foundation for better understanding of the safety assessment operation management maintenance and reinforcement for long span bridges and motivates further research and development for more advanced reliability and serviceability assessment techniques for long span bridges **Journal of Pressure Vessel Technology** ,1980 *Mechanical Vibration* Haym Benaroya,Mark Nagurka,Seon Mi Han,2022-07-15 Mechanical Vibration Analysis Uncertainty and Control presents comprehensive coverage of the fundamental principles of mechanical vibration including the theory of vibration as well as discussions and examples of

the applications of these principles to practical engineering problems In dealing with the subject of vibration the engineer must also consider the effects of uncertainties in the analysis and methods for the control of vibration As such this book includes treatment of both subjects modeling of uncertainties and vibration control Many example problems with solutions are included and are been carefully chosen and are presented at strategic points enabling the reader to have a thorough understanding of the subject and to help cement core ideas the book includes compelling case studies and stories of real world applications of mechanical vibration Smart Monitoring of Rotating Machinery for Industry 4.0 Fakher Chaari,Xavier Chiementin,Radoslaw Zimroz,Fabrice Bolaers,Mohamed Haddar,2021-08-20 This book offers an overview of current methods for the intelligent monitoring of rotating machines It describes the foundations of smart monitoring guiding readers to develop appropriate machine learning and statistical models for answering important challenges such as the management and analysis of a large volume of data It also discusses real world case studies highlighting some practical issues and proposing solutions to them The book offers extensive information on research trends and innovative strategies to solve emerging practical issues It addresses both academics and professionals dealing with condition monitoring and mechanical and production engineering issues in the era of industry 4 0 **The Shock and Vibration Digest** ,1987-07

Mechanical Engineering and Materials Jinyang Xu,Krishna Murari Pandey,2021-03-24 This book gathers the latest advances innovations and applications in the field of mechanical engineering as presented by leading international researchers and engineers at the 2020 International Conference on Mechanical Engineering and Materials ICMEM held in Beijing China on October 16 17 2020 ICMEM covers all aspects of mechanical engineering and material sciences such as computer aided design virtual design and design visualization intelligent design usability design automobile structure human machine interface design manufacturing engineering aerospace engineering automation and robotics micro machining MEMS NEMS composite materials biomaterials smart materials superconducting materials materials properties and applications materials manufacturing nanotechnology nano materials and nano composites etc The contributions which were selected by means of a rigorous international peer review process highlight numerous exciting ideas that will spur novel research directions and foster multidisciplinary collaborations *Dynamics of Fluid-structure Systems in the Energy Industry* M. K. Au-Yang,Samuel J. Brown,1979 *Proceedings of China SAE Congress 2019: Selected Papers* China Society of Automotive Engineers,2020-11-04 These proceedings gather outstanding papers presented at the China SAE Congress 2019 Featuring contributions mainly from China the biggest carmaker as well as most dynamic car market in the world the book covers a wide range of automotive topics and the latest technical advances in the industry Many of the approaches included can help technicians to solve practical problems that affect their daily work In addition the book offers valuable technical support to engineers researchers and postgraduate students in the field of automotive engineering Advances in Engineering Materials, Structures and Systems: Innovations, Mechanics and Applications Alphose Zingoni,2019-08-21

Advances in Engineering Materials Structures and Systems Innovations Mechanics and Applications comprises 411 papers that were presented at SEMC 2019 the Seventh International Conference on Structural Engineering Mechanics and Computation held in Cape Town South Africa from 2 to 4 September 2019 The subject matter reflects the broad scope of SEMC conferences and covers a wide variety of engineering materials both traditional and innovative and many types of structures The many topics featured in these Proceedings can be classified into six broad categories that deal with i the mechanics of materials and fluids elasticity plasticity flow through porous media fluid dynamics fracture fatigue damage delamination corrosion bond creep shrinkage etc ii the mechanics of structures and systems structural dynamics vibration seismic response soil structure interaction fluid structure interaction response to blast and impact response to fire structural stability buckling collapse behaviour iii the numerical modelling and experimental testing of materials and structures numerical methods simulation techniques multi scale modelling computational modelling laboratory testing field testing experimental measurements iv innovations and special structures nanostructures adaptive structures smart structures composite structures bio inspired structures shell structures membranes space structures lightweight structures long span structures tall buildings wind turbines etc v design in traditional engineering materials steel concrete steel concrete composite aluminium masonry timber glass vi the process of structural engineering conceptualisation planning analysis design optimization construction assembly manufacture testing maintenance monitoring assessment repair strengthening retrofitting decommissioning The SEMC 2019 Proceedings will be of interest to civil structural mechanical marine and aerospace engineers Researchers developers practitioners and academics in these disciplines will find them useful Two versions of the papers are available Short versions intended to be concise but self contained summaries of the full papers are in this printed book The full versions of the papers are in the e book *Engineering Asset Management - Systems, Professional Practices and Certification* Peter W. Tse,Joseph Mathew,King Wong,Rocky Lam,C.N. Ko,2014-12-09 This proceeding represents state of the art trends and developments in the emerging field of engineering asset management as presented at the Eight World Congress on Engineering Asset Management WCEAM The Proceedings of the WCEAM 2013 is an excellent reference for practitioners researchers and students in the multidisciplinary field of asset management covering topics such as Asset condition monitoring and intelligent maintenance 2 Asset data warehousing data mining and fusion 3 Asset performance and level of service models 4 Design and life cycle integrity of physical assets 5 Deterioration and preservation models for assets 6 Education and training in asset management 7 Engineering standards in asset management 8 Fault diagnosis and prognostics 9 Financial analysis methods for physical assets 10 Human dimensions in integrated asset management 11 Information quality management 12 Information systems and knowledge management 13 Intelligent sensors and devices 14 Maintenance strategies in asset management 15 Optimisation decisions in asset management 16 Risk management in asset management 17 Strategic asset management 18 Sustainability in asset management King WONG

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2018 — YALE (J813) GDP45VX6 LIFT TRUCK Service Repair Manual. Page 1. Service Repair ... Techtronix Transmission. 20 liter (21.0 qt). John Deere JDM J20C. Type of transmission fluid for Yale Lift truck Sep 16, 2014 — They said it is a special oil and if we put in 30 wt oil or Dextron ATF we will destroy the transmission. Since the lift truck is at a job site ... Veracitor ® GC-SVX The Techtronix 100 transmission offers improved tire and fuel costs through ... with service details in mind. The cowl-to-counterweight access makes servicing ... Tektronix - Transmission Lines - YouTube SAMHSA's National Helpline Jun 9, 2023 — SAMHSA's National Helpline is a free, confidential, 24/7, 365-day-a-year treatment referral and information service (in English and Spanish) ... Staying Sober: A Guide for Relapse Prevention Mr. Gorski is the author of numerous books, audio, and video tapes, including Passages Through Recovery -- An Action Plan for Preventing Relapse, Staying Sober ... Hazelden Store: Staying Sober In Staying Sober the authors discuss addictive disease and its physical, psychological, and social effects. They also identify sobriety-based symptoms, ... Staying Sober: A Guide for Relapse Prevention Staying Sober explains addictive disease, Post Acute Withdrawal (PAW), recovery and partial recovery, mistaken beliefs about recovery and relapse, the relapse ... Staying Sober Terence Gorski Sober On A Drunk Planet: 3 Sober Steps. An Uncommon Guide To Stop Drinking and Master Your Sobriety (Quit Lit Sobriety Series). by Sean Alexander. Staying Sober: A Guide for Relapse Prevention Read 18 reviews from the world's largest community for readers. Very good. Scuffed edges and some on cover. Small crease across back upper corner. Few dog-... Staying Sober: A Guide for Relapse Prevention CEU course for Addiction Counselors and Social Workers Staying Sober A Guide for Relapse Prevention; This book is a great resource for understanding and ... Staying sober : a guide for relapse prevention. Staying sober : a guide for relapse prevention. Gorski, Terence T. (Author). Miller, Merlene. (Added ... List of books by author Terence T. Gorski Staying Sober: A Guide for Relapse Prevention 083090459X Book Cover · Passages Through Recovery: An Action Plan for Preventing Relapse 1568381395 Book Cover. Staying sober : a guide for relapse prevention Staying sober : a guide for relapse prevention Available at Andrew L. Bouwhuis Library Book Shelves (RC565 .G68 1986) ...