

PIPING VIBRATION ANALYSIS

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Mr. Wachel has a BSME and MSME degrees from the University of Texas. He is an ASME Fellow and a member of ASM, The Vibration Institute, and is a Registered Professional Engineer in the State of Texas.



Scott J. Morton is a Project Engineer with Engineering Dynamics, Incorporated. He has experience in computer modelling in finite elements, rotor-dynamics and acoustics. He is also involved in the diagnostic field testing of rotating and reciprocating equipment and in the evaluation of structural and piping vibration problems.

Mr. Morton holds Bachelors and Masters degrees in Maritime Systems and Ocean Engineering from Texas A&M University and is a Registered Professional Engineer in the State of Texas.



Kenneth E. Atkins is a Senior Project Engineer with Engineering Dynamics, Incorporated, and has experience in performing lateral and torsional critical speed analyses, rotor stability analyses and the evaluation of structural vibration problems using finite element methods. He has been actively involved in field troubleshooting of a wide variety of rotor-dynamics, structural, and piping vibration problems.

Mr. Atkins received a B.S. degree in Engineering Science from Trinity University in 1978. He is a member of ASME and is a Registered Professional Engineer in the State of Texas.

ABSTRACT

Excessive piping vibrations are a major cause of machinery downtime, leaks, fatigue failures, high noise, fires, and explosions in refineries and petrochemical plants. Excessive vibration levels usually occur when a mechanical natural frequency of the piping system is excited by some pulsation or mechanical source. The vibration mode shapes usually involve lateral vibrations and/or shell wall radial vibrations.

Simplified methods are presented for analyzing lateral and shell wall piping vibrations and judging their severity. The methods are thought to be conservative and are intended to be used as screening criteria to determine if more sophisticated analyses, such as computer stress modelling or strain gage testing are necessary. Frequency factors for calculating the mechanical natural frequencies for the classical piping configurations (uniform straight beams) and various piping bend configurations are presented. Factors are presented to compensate the natural frequency calculations for concentrated and distributed weight effects.

The relationships between piping vibration displacement, velocity and stress are presented and criteria for judging the severity of piping vibration in terms of the endurance stress limit are shown. The mechanisms that can excite piping vibrations will be discussed, as well as methods for controlling their severity.

INTRODUCTION

Piping vibration failures have been one of the major causes of downtime, fires and explosions in industrial plants over the past 30 years. For example, one piping failure at a petrochemical

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Proceedings of the 10th Chinese Society of Aeronautics and Astronautics Youth Forum Chinese Society of Aeronautics and Astronautics, 2023-01-01 The Chinese Society of Aeronautics and Astronautics holds the Youth Science and Technology Forum biannually which aims to assess the state of aviation science and technology recognize advanced scientific and technological accomplishments foster the development of young aviation science and technology talents and provide a platform for young science and technology workers to track the frontier of science and technology exchange novel ideas and accurately meet the needs of the aviation industry This book contains original peer reviewed research papers from the conference Topics covered include but are not limited to navigation guidance and control technologies key technologies for aircraft design and overall optimization aviation test technologies aviation airborne systems electromechanical technologies structural design aerodynamics and flight mechanics other related technologies advanced aviation materials and manufacturing technologies advanced aviation propulsion technologies and civil aviation transportation Researchers engineers and students find this book to be a useful resource because the articles provided here discuss the most recent advancements in aviation science and technology *Advances in Intelligent Structure and Vibration Control* Ai Min Yang, Wen Jiang Du, 2012-03-15 Selected peer reviewed papers from the International Conference on Intelligent Structure and Vibration Control ISVC 2012 March 16 18 2012 Chongqing China Automation Equipment and Systems Wen Zhe Chen, Pin Qiang Dai, Yong Lu Chen, Ding Ning Chen, Zheng Yi Jiang, 2012-02-27 Selected peer reviewed papers from the 3rd international Conference on Manufacturing Science and Engineering ICMSE 2012 March 27 29 2012 Xiamen China *The Shock and Vibration Digest*, 1993 Offshore Pipelines Boyun Guo, Shanhong Song Ph.D., Ali Ghalambor, Tian Ran Lin PhD, 2013-07-24 The development of oil and gas fields offshore requires specialized pipeline equipment The structures must be strong enough to with stand the harshest environments and ensure that production is not interrupted and remains economically feasible However recent events in the Gulf of Mexico have placed a new importance on maintenance and reliability A new section Condition Based Maintenance CBM introduces the subject of maintenance written by Tian Ran Lin Queensland University of Technology and Yong Sun CSIRO Earth Science and Resource Engineering Two of the main objectives of CBM is maximizing reliability while preventing major or minor equipment malfunction and minimizing maintenance costs In this new section the authors deal with the multi objective condition based maintenance optimization problem CBM provides two major advantages 1 an efficient approach for weighting maintenance objectives and 2 a method for specifying physical methods for achieving those objectives Maintenance cost and reliability objectives are calculated based on proportional hazards model and a control limit CBM replacement policy Written primarily for engineers and management personnel working on offshore and deepwater oil and gas pipelines this book covers the fundamentals needed to design Install and commission pipeline projects This new section along with a thorough update of the existing chapters

represents a 30% increase in information over the previous edition Covers offshore maintenance and maintenance support system Provides the fundamentals needed to design Install and commission pipeline project Methods and tools to deliver cost effective maintenance cost and system reliability New section on Condition Based Maintenance written by Tian Ran Lin Queensland University of Technology and Yong Sun CSIRO Earth Science and Resource Engineering yong.sun@csiro.au

Mechanics of Structures and Materials XXIV Hong Hao, Chunwei Zhang, 2019-08-08 Mechanics of Structures and Materials Advancements and Challenges is a collection of peer reviewed papers presented at the 24th Australasian Conference on the Mechanics of Structures and Materials ACMSM24 Curtin University Perth Western Australia 6-9 December 2016 The contributions from academics researchers and practising engineers from Australasian Asia Pacific region and around the world cover a wide range of topics including Structural mechanics Computational mechanics Reinforced and prestressed concrete structures Steel structures Composite structures Civil engineering materials Fire engineering Coastal and offshore structures Dynamic analysis of structures Structural health monitoring and damage identification Structural reliability analysis and design Structural optimization Fracture and damage mechanics Soil mechanics and foundation engineering Pavement materials and technology Shock and impact loading Earthquake loading Traffic and other man made loadings Wave and wind loading Thermal effects Design codes Mechanics of Structures and Materials Advancements and Challenges will be of interest to academics and professionals involved in Structural Engineering and Materials Science

Applied Mechanics Reviews, 1986 **Vibration and Control of Mechanical Systems--2001** H. R. Hamidzadeh, Homer Rahnejat, Albert C. J. Luo, 2001 **Design and Analysis of Piping, Vessels, and Components--2002** Artin A. Dermenjian, 2002 Annotation This volume of proceedings from the August 2002 conference consists of 26 technical papers from six sessions on the design and analysis of pressure vessels heat exchangers piping and components Among the topics are a structural evaluation of a piping system subject to thermal stratification dynamic pipe stresses during water hammer and fatigue life prediction for short dents in petroleum pipelines Other topics include the design of ellipsoidal heads using elastic finite element analysis vibration modes of spherical shells and containment vessels and convergence of the axisymmetric Bessel function solution to the pipe strap anchor problem No subject index Annotation c Book News Inc Portland OR booknews.com

Fluid Transients and Structural Interactions in Piping Systems Paul H. Rothe, D. C. Wiggert, 1981 **Pressure Vessels and Piping** S. Y. Zamrik, David Dietrich, 1982 **Transactions of the 7th International Conference on Structural Mechanics in Reactor Technology, Marriott Hotel, Chicago, Illinois, U.S.A., August 22-26, 1983**, 1983 Proceedings of the ASME Pressure Vessels and Piping Conference--2006: Fluid-structure interaction, 2007 Proceedings of the ASME Turbo Expo ..., 2004 **Welding Research Council Bulletin Series** Welding Research Council (U.S.), 1996 *Companion Guide to the ASME Boiler & Pressure Vessel Code* K. R. Rao, 2006 This is Volume 2 of the fully revised second edition Organized to provide the technical professional with ready

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