DOWNLOAD PDF MACHINERY DYNAMICS APPLICATIONS AND VIBRATION CONTROL PROBLEMS

Chapter 1 : Visitors - Linear and Nonlinear Dynamics and Vibrations Laboratory

2. Machinery dynamics - Applications and vibration control problems: Presented at the ASME design technical conferences. Biennial conference on mechanical vibration and noise, Montreal, Que. 2. New York, N.Y. 3. Machinery dynamics - applications and vibration control problems.

Forces below lbf, well below guideline 1. Finite element FE model. Wood will quickly generate an accurate FE model of the pump, vessels, piping system, and key areas of the skid if applicable. Some piping finite element analysis FEA programs are not recommended for this application. Complex geometries are accurately modelled using shell or solid elements. Rotational inertias are included. Mechanical natural frequencies MNFs. The MNFs and mode shapes are determined for the key components in the system, with results published in the report. A detailed report is provided, summarizing recommendations and mechanical results. A mechanical analysis requires accurate FE models of the pump piping system to determine MNFs and avoid resonance. Models are also used in Forced Response Analysis option below to determine vibration and stress amplitudes. Field experience and measurements are required to accurately define boundary conditions, dynamic forces, and practical recommendations to avoid problems. For some applications defining 20 operating points included in the standard study will not sufficiently cover the range of operating conditions and load steps to ensure all potential pulsation and vibration problem areas are evaluated. Wood can provide assistance in defining the recommended number of conditions to analyze. This analysis is recommended when frequency avoidance recommendations cannot be achieved or implemented. The study includes all significant pump forces including fluid stretch forces, pulsation forces, and moments and couples and will evaluate vibration and stress to API and industry guidelines. There are two locations where this option is conducted: Pump manifold system - analysis of the dampeners and piping around the pump frame; and Piping away from the manifold - recommended when the pulsation force guideline cannot be met, or the Frequency Avoidance Analysis recommendations cannot be implemented. Off-skid or station piping. Wood will assess pulsations in piping away from the pump package if information is available. Multi-unit Analysis interaction between units. When multiple pumps are connected together in series or parallel, Wood will evaluate pulsations in headers and plant piping system including interaction between units. Water hammer analysis, also known as a transient surge analysis for liquid systems, is another optional study that is sometimes required when reciprocating pump and piping systems are affected by transient events such as power outages, valve swings, check valve slam, and other causes. Some operators require an investigation of transients in the system to ensure integrity under upset conditions. See Water Hammer Analysis 2 Wood Advantages Wood is a global leader in pulsation analysis because of these unique factors: Fully integrated vibration solution offered that includes design and field support of compressors, pumps, and piping to ensure your reliability and integrity management requirements are met Involved with and leads industry research projects for the Gas Machinery Research Council GMRC resulting in superior knowledge and expertise Active member in API and GMRC vibration task force committees 3 Customer Benefits As the global market leader in pulsation design services, Wood is able to offer a number of unique services and features including accurate pulsation and mechanical analysis that benefit the owner. These benefits include higher system reliability, minimized pressure drop and performance losses, faster turnaround in the design, optimized vessel sizes, and lower overall costs. Pulsation forces controlled throughout the piping system Piping and vessel vibration minimized Complete range of operating conditions evaluated Recommendations provided that represent a balance of all competing requirements pulsation control, added pressure drop, mechanical constraints, and practical implementation Effective reporting and analysis for useful field analysis and monitoring 4 Related Information The pulsation and mechanical analysis for reciprocating pumps is quite similar to the analysis offered for reciprocating compressors. For explanation of the issues, please refer our Knowledge Center for videos and articles relating to these subjects.

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Chapter 2 : Noise, Vibration & Harshness I (ME) | E-Learning Portal

Get this from a library! Machinery dynamics, applications and vibration control problems: presented at the ASME design technical conferences, 12th Biennial Conference on Mechanical Vibration and Noise, Montreal, Quebec, Canada, September ,

Bode plot Order tracking VLD-Monitor has a simple data configuration setup allowing the operator full control of data processing and visualization of data. VLD-Monitor is an online recording and processing system that is logging a selection of signals infinite simultaneously. The logged data is stored in a binary file format and the data file is constantly updated until either the logging process is terminated manually or through a setting in the setup file. A separate backup file is created in parallel. Graphical representation of logged data is automatically prepared and made available to stakeholders of choice, whether local or distant presence. VLD-Monitor is a stand-alone system that will automatically re-boot if power is lost and regained again. The data setting and logging process will initiate without any external interference. However, the system is made available and can be displayed and operated using the Microsoft Remote Desktop application software or similar. The system configuration will be based on type of equipment, type of system, recognized industry standards and explicit client requirements. VLD-Monitor data input is either online data sensors permanently installed on equipment , offline data data measured manually using provided handheld data acquisition tool or both. All data, whether online or offline is processed in the one and same database allowing a flexible and "one-system" approach to equipment monitoring and maintenance. SUMMARY Rotating and reciprocating equipment will experience wear as a result of operation and critical equipment, whether small or large, should be subject to a maintenance scheme. The most commonly used maintenance setup in the industry is predictive maintenance PM. PM is typically based on manufacturer requirements and industry experience and is largely considered a conservative approach. A huge drawback with PM setup is that it cannot predict unforeseen wear or failure to equipment developing. The VLD-Monitor will help you reduce the risk of unscheduled shutdowns and costly downtime and repairs to your asset. The company knowledge and work experience is based on several years of working as consultants within this field of expertise. By close dialog and cooperation with technical universities and clients we aim to strengthen existing and develop new methods to obtain best suitable technical and commercial balanced solutions. Working with clients worldwide, a variety of technical challenges have been undertaken that includes technical reviews, advanced numerical calculations, onsite measurements and data processing. Lauridsen has more than 15 years of experience working as a Consultant Engineer in the marine and energy business. Lars has handled a wide range of projects working both onshore and offshore. He is a specialist in vibrations, finite element analysis, programming, solid mechanics, topology optimization, numerical analysis and signal analysis of measurements. Lars studied Mechanical Engineering M. His experience includes analysis and troubleshooting of turbomachinary, windturbine drive trains and propulsion systems. Per studied Mechanical Engineering M. John is a pioneer within ship acoustics and one of the first to emphasize the importance of noise and vibration control on luxury yachts.

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Chapter 3 : API Pulsation & Mechanical Analysis: Reciprocating Pump | Vibration, dynamics and noise

Machine Dynamics, Inc. is dedicated to correcting vibration problems and to spreading this predictive maintenance technology through articles, books, and professional training. Machine Dynamics, Inc. is a veteran-owned, professional consulting firm founded in

Other industries Heavy Industry Consulting on a Wide Variety of Projects We characterize complex often multi variable problems, design tests to diagnose the root cause of the issue, and to provide engineered solutions See Manufacturing and Plant Process. Often times vibration problems and acoustic noise problems can be very complex and subtle. As a result, it is often our role as the Vibration Consultant, or Acoustic Noise Consultant, to perform vibration analysis, vibration testing, acoustic analysis and acoustic testing to develop an understanding of the problem and to provide a means for the rest of the design team to directly visualize the problem, whether it is the vibration deformation mode shapes associated with problem resonances, or with the distribution of the acoustic noise power radiating from a complex product. Once the design team can visualize the problem, developing the solution becomes much more straightforward. We enjoy doing this work well because we are well grounded in basic applied physics, digital signal processing, structural dynamics and vibro-acoustics, and how they relate to system and facility vibration and acoustic noise issues on a myriad of levels. We are expert vibration consultants in resonance testing, Modal Analysis , Operating Defection Shape Testing ODS , steady state and transient analysis , with literally decades of experience developing our detailed methodologies that produce meaningful results. These FRF measurements form the basis of modal analysis and the theory of linear system structural dynamics. We are fluent in spectral analysis and the digital signal processing inherent in the vibration analysis measurement process, and thus we can spot problems before they corrupt a whole dataset, or an entire project. Tools of the Trade for Structural Dynamics Testing Non-linearities exist in all physical structures and are often not a problem. However, when they are involved, we know how to spot them and deal with these unique dynamics. We have refined these vibration consulting skills for more than 30 years. The physical principles of structural dynamics, acoustics, optics, and thermodynamics apply to structures and systems large and small. The wide variety of our projects keeps our work interesting, after all these years, even as we apply the same fundamentals again and again. Meaningful Test Data, Knowing Good Data From Bad We use our vibration testing and noise testing expertise, as well as various methods of analytic, computer modeling and Finite Element Analysis FEA to make sense of the complex vibration problems and noise problems, thereby enabling efficient solutions. The Most Important Step We know from our extensive experience as Vibration Consultants and as Acoustic Consultants that the initial assessment is critical to asking the right questions at the start of investigation. These questions will lead to a set of initial hypotheses about the issues at hand. A sound foundation of vibration and acoustci noise theory, basic physics, strong mechanical intuition, and years of structural dynamics experience are necessary to design an effective set of tests. The limitations of where instrumentation can be placed, the inherent sensor limitations, and the impact on the system dynamics need to be considered. Thus, designing the experimental setup to extract meaningful vibration analysis and acoustic analysis results is perhaps the most important step in solving a pressing issue where time, patience, and resources are in short supply. This is very important. We test and analyze the change in dynamics we are trying to create in real-time, on site, and often make changes to our experimental test plan on the fly as we discover how a system is actually behaving. In doing so we often get meaningful results from which we can make sound engineering decisions in a short time frame. We do NOT make measurements and spit out data. We focus on the important dynamic parameters of the system and its boundary conditions, and design tests to prove or disprove hypotheses. When performing vibration analysis and vibration testing, there are countless ways to create erroneous results. It takes effort and experience to extract meaningful results, interpret them, and then engineer creative and sound solutions. Whether it involves testing in the cleanroom instrumenting a delicate optical interferometer using a tiny non-contact capacitive

sensor, or climbing through a power plant structure running hundreds of feet of cable to an accelerometer array to troubleshoot a Turbine Isolation Issue , we often employ many of the same principles, concepts, and methodologies of vibration analysis and acoustic analysis. As Vibration Consultants and as Acoustic Consultants we use our specialized skill set, and a vast selection of instrumentation that we have collected for over 3 decades, to design tests and solve complex problems. Multi-Variable Testing Multivariable testing is usually necessary to really get a handle on an issue involving multiple disciplines of physics. We design tests to measure static and dynamic strain, acoustic noise static and dynamic pressure, vibration acceleration, velocity and displacement, magnetic field, temperature, fluid flow, and light intensity, to name a few. Real world problems involving the measurement of multiple variables require an understanding of the physics of the coupling between them, as well as the physics and limitations of the measurement instrumentation. Problems in different frequency ranges necessitate unique approaches involving instrument selection, mounting dynamics, cabling, and coupling with other structures and media. Multi-variable Testing Measurements of Ambient Acoustic Noise, Floor Vibration, and the Frequency Response of the Semiconductor Tool Response Showing Resonances that Dictate the Disturbance Response of the Tool to the Environment For instance, when a consumer product is too noisy, a bedside medical device for example, in addition to the acoustic analysis and testing, thermal analysis and heat flow optimization of the cooling system will often be part of the acoustic solution, in addition to surface damping treatments , motor vibration isolation, etc. In debugging scanning electron microscopes SEMs issues, disturbances due to acoustic excitation, floor vibration, control instability, frame resonances, thermal drift, and magnetic field all superimpose to create a confounding image disturbance. Additionally, each of these disturbances can be aliased. We have years of experience untangling overlapping disturbances involving multiple sources to make the issue understandable, and allow for educated decisions when weighing different solution strategies. We do this prototype testing carefully, with more than 30 years of structural dynamics and acoustics experience as vibration consultants, always working hard to test and keep an accurate understanding of the current system dynamics and the boundary conditions associated with our vibration testing and vibration analysis as we make changes. Tuned Mass Damper Design for Biotech Optical Tool However, as so often happens to our clients, when quick and dirty fixes are attempted by other engineers with little structural dynamics experience, confusion, delay, and uncertainty regarding the design of the experiment often result. A faulty vibration test often leads to the wrong conclusion and drives the wrong action path away from a good solution. Valuable development time is often wasted, and the issue soon becomes an emergency. For more detailed breakdown of this See our discussion on Product and Facility Emergencies. We have the experience as vibration consultants and as acoustic consultants, to quickly analyze past test methodologies and explain for the team what has been done well, and what needs improving, tweaking, or additional attention to a particular dynamic parameter. This is important for getting an engineering team all on the same page by making sure everyone understands the problem, what has been done, and how to move forward. These unique abilities have brought us long lasting working relationships with our clients. We help get the design right from the 1st alpha system to avoid last minute emergencies. We have recently worked in the design phase performing analytical and experimental vibration analyses on a table top scanning electron microscope, a table top genomics ID system, and worked though the design and test of a cutting edge bio-tech imaging system with 25 nm resolution that will perform on upper floors of light construction. As vibration consultants and as acoustic noise consultants, we have quieted noisy dialysis machines, eye surgery equipment, surgical robots, semiconductor imaging tools, and multi-ton solar tracking arrays. These facilities include state of the art semiconductor research facilities, university research buildings, tech-group collaborative office spaces, and others. Facility Issues Include Floor Vibration and Acoustic Noise Visualization of a Floor Resonance Measured at a Surgical Facility Using Modal Analysis Field Testing New facility design considerations that require our expertise include HVAC acoustic design, mechanical room design, equipment vibration isolation mounting, sensitive tool placement, floor system design, wall and partition design, sound masking, active cancellation of vibration and acoustic

noise, passive acoustics added reverberation, or added sound absorption in particular frequency bands. We perform the Sensitivity Testing and write the specifications for some of the high resolution imaging and testing systems used in these industries. Additionally, we have spent decades working with facilities teams to troubleshoot their facility issues and thus we have intimate knowledge of what issues to expect and how to prevent them. We translate that knowledge into design specifications and work with the design team on these critical design details. It is these past clients that most often call us in the design phase of the product where we provide very valuable input in design reviews helping to show where potential pitfalls may found, and where great improvement may be had by the adjustment of a few engineering details. In product development we provide assistance at several points along the product development cycle. Firstly, we provide assistance and guidance in the development of conceptual and detailed design often using a combination of analytic, numerical, and Finite Element Modeling. Our extensive experience as Vibration Consultants allows us to see potential pitfalls and find winning solutions, as part of your team, in the start of the design process. This is critical to staying on budget, on schedule, and meeting performance goals. Once the prototype has been built, we perform vibration measurements and vibration analysis of the dynamic response of these systems to expected disturbances, including both internal vibration and acoustic noise sources such as X-Y stage stopping transients and external sources such as floor vibration and HVAC acoustic noise. In addition, determination of system resonances by Modal Testing and analysis often provides critical design information. If necessary, the design is then improved by making appropriate changes in structural design, Stage Control , Vibration Isolation , and Damping Treatment. We use our testing and analysis to explain why a system performs as it does, and why the modification will improve performance. Our experience as vibration consultants allows us to be both efficient and thorough, minimizing troubleshooting, tool time, and prototype iterations. Our founder, Reuben Hale, P. Similarly, our other senior staff member, Susan Reno MSE is also extremely skilled and an experienced vibration engineer, having more than 10 years experience working with Response Dynamics. We love what we do and are at the very top of our unique field. Our website is put together by our engineers. Response Dynamics also consults extensively for the end users of sensitive equipment, such as semiconductor production facilities and academic and commercial research laboratories, hospitals, Pharmaceutical laboratories, etc.. We work as Vibration Consultants and as Acoustic Consultants to consult on existing facilities as well as on the design of new facilities to address issues associated with providing the necessary environment with appropriate levels of floor vibration, acoustic noise and stray magnetic fields required for optimal performance of their sensitive equipment. Additonally, we work with facility design teams on the design of new office workspaces to meet the design goal of creating an excellent productive workspace environments for employees. As vibration consultants working on system vibration and facility vibration issues, we use vibration testing and vibration analysis to characterize the vibration symptoms, and to make visible the structural dynamics responsible, identify sources, disturbance paths, and how coupling of sources with the structural dynamics manifest the problem issue at hand, to efficiently drive to a viable solution. As acoustic consultants working on system noise and facility noise issues, we often start with an acoustic characterization of the issue, then put on our vibration consultant hats and show where, how and why the disturbing structures are vibrating to produce the acoustic disturbances. We then often test the acoustic parameters of absorption and reverberation and explain why the acoustic source is producing the noise levels it does given the frequency content of the disturbance and the enclosure geometry. As magnetic field consultants we characterize low frequency fields, mainly 20 kHz and below all the way down to the very low frequencies to what might be called "DC fluctuations". Our extensive experience with micro-vibration and acoustic issues in the structural dynamics of sensitive high-resolution manufacturing, testing and imaging systems, makes us leaders in the field of vibration analysis and testing of sub-micron and nanometer scale technology.

Chapter 4 : Vibration Control Solutions - About us - GERB USA

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A Brief Tutorial on Machine Vibration by Victor Wowk, P.E. Machine Dynamics, Inc. The purpose of this tutorial is to provide sufficient knowledge to understand machine vibration.

Chapter 5 : VL DYNAMICS|ENGINEERING CONSULTANCY

Many field related vibration problems are due to a lack of vibration design analysis. We often hear from customers that better specifications will avoid these problems and ensure that the right technical scope is completed on compressors, pumps, or the piping system.

Chapter 6 : Specifications | Vibration, dynamics and noise

For some applications defining 20 operating points (included in the standard study) will not sufficiently cover the range of operating conditions and load steps to ensure all potential pulsation and vibration problem areas are evaluated.

Chapter 7 : Manufacturing and Process, Vibration Control Solutions - DEICON

This course is targeted at solving complex vibration problems involving transient and forced vibrations; resonance, isolation and damping. It is partial preparation for the ISO/IEC Vibration Analyst Category IV Certification Exam.

Chapter 8 : Mechanical Vibration | Engineering Dynamics | Mechanical Engineering | MIT OpenCourseWar

The study of vibration will emphasize the analysis of the solution of the equations of motion of a particularly important class of dynamics problems: the vibration of machines. Balance scales are simple tools that can give the mass of an object relative to another object through finding the equilibrium point.

Chapter 9 : Mechanics and Vibrations - Mechanical Engineering - Purdue University

Basic Machinery Vibration Correspondence Course: For those who are unable to attend a course in person, this program is also available through through self-study for either continuing education or for exam course requirement credit.