COLLECTION OF SOLVED PROBLEMS IN VIBRATION pdf

1: Vibration Problems - [PDF Document]

I'm a student of technical faculty and book "Collection of Solved Problems in Vibration" has helped me to learn the vibration problems solving. There is a review of theory at the beginning of every chapter in the book and solved problems after that.

Understand the factors that may cause noise or vibrations in HVAC systems. Learn various methods to mitigate vibration, sound, or noise problems. In the HVAC industry, most sound or noise is generated via rotating equipment and air and fluid movement through ducts and pipes. This movement creates vibration, sound, or noise. Technically, sound is a wave of mechanical energy that moves through matter. Noise is undesirable sound or sound without value. In this discussion, we will use sound and noise synonymously. Vibration in its simplest form can be considered an oscillation or repetitive motion of an object around an equilibrium position. In the HVAC industry, sound is not generated without some form of vibration from equipment. Although sound is not present without vibration, there can be vibration without sound noticeable to the human ear. Therefore, the best way to reduce sound is to limit the vibration produced by mechanical equipment. Examples are rotating shafts or gears, thermal processes such as combustion, or fluid dynamic means such as airflow through a duct or fan interactions with air. Understanding vibration and sound Control of HVAC system sound and vibration are of equal importance, but measurement of vibration is often not necessary to determine sources or transmission paths of unwanted sound or noise. Because vibration is the source of noise from HVAC systems, management of those conditions is imperative to a quiet design. System design that neglects to properly address vibration may result in malfunctioning components, noise, and, in some cases, catastrophic failure. There are two facets of vibration management: Isolation is the prevention of vibration from entering the system and dissipating it by changing kinetic energy of vibration into a different form of energy, such as heat. Vibration isolation systems for mechanical components require some amount of damping. Damping dissipates mechanical energy from the system and attenuates vibrations more quickly. Without damping, these systems may vibrate for some time before coming to rest. The fluid in automotive shock absorbers is a kind of damper, as is the inherent damping in elastomeric rubber equipment mounts described below. This energy is converted to heat in the shock absorber or rubber mounts. There are also pads made of neoprene or cork used in equipment mounting that can be identified as damping devices. These two forms of vibration management are different from each other, but are often used in conjunction with each other to achieve the desired performance. In this discussion, vibration damping will generally fall under the category of vibration isolation. The amplitude of the sound wave represents the loudness and is measured in decibels. The louder the sound, the larger the amplitude or decibels see Figure 1. A- and C-weighted sound pressure A-weighted sound pressure measured in decibels; dBA has been used for 60 years as a single-number measure of the relative loudness of noise, specifically for outdoor environmental noise standards. It is popular because it is a single number that most sound meters include. The C-weighted curve dBC , which is more sensitive to low-frequency sound, contributes less to the overall sound level than dBA. The human ear has a relatively poor sensitivity to low-frequency sound in the to dBA range. When attenuating sound for an outdoor installation of an air-cooled chiller, the manufacturer-supplied decibel rating would be compared to design decibel level at the design distance from the source. If the design level is exceeded, attenuation will be required. Acoustic screen walls or manufacturer-supplied attenuation enclosures can be added, or relocating the chiller farther from the sound-sensitive area may be the answer.

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2: Collection of Solved Problems in Physics

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To solve a vibration issue quickly and avoid such undesirable outcomes, an important first step is to determine if the source of the increased vibration is resonance in the rotating equipment or in a supporting structure. Resonant vibration in mechanical structures such as pumps, turbines and motors occurs when a natural frequency is at or close to a forcing frequency such as rotor speed. When present, this condition can cause severe vibration levels by amplifying small vibratory forces from machine operation. Such problems often develop after a speed change has been implemented, as with retrofitting a machine with an adjustable-speed drive ASD or operating a 50 Hz motor on 60 Hz power. The solution frequently depends on the ability to distinguish between structural resonance and a rotor critical speed. Structural resonance refers to excessive vibrations of non-rotating components, usually machine parts or supporting structures. Due to the complexity of these components, it is the more common resonant condition and usually occurs at or near the rotating speed of the machine. Even slight vibratory forces from residual unbalance and misalignment effects of the machine can excite the resonant base structure, resulting in severe vibration. A good example of this is the reed frequency vibration that often occurs with vertical turbine pumps that have a motor mounted on top of the discharge elbow. Machine components can also be resonant; there are many examples of two-pole electric motors where a resonant end bracket caused very high axial vibration at 1 x rpm or 2 x rpm. This is common with centrifugal pumps, gas and steam turbines, and large, two-pole electric motors. While the result is similar to structural resonance high vibration at a certain operating speed , a rotor critical speed is a more complex phenomenon. When the operating speed reaches the resonant frequency of the rotating element, the rotating element distorts and the vibratory forces increase significantly. It is important to properly distinguish between structural resonance and rotor critical speed. The term "critical speed" without the word "rotor" is somewhat ambiguous. Technically, a critical speed could be either a structural resonance or a rotor critical speed. The simple term "resonance" can be applied to both conditions to avoid confusion. The characteristics of resonance As described above, the most notable characteristic of resonance is increased vibration when a certain operating speed is reached. It will also be observed that as the operating speed is increased beyond the resonant frequency, the vibration amplitude will decrease somewhat. The Bode plot in Figure 1 shows the operating speed versus the amplitude. For the sake of illustration, assume that the exciting force is residual unbalance of the rotor at the rotating speed. The formula for calculating the natural frequency is: Where "K" is the stiffness of the resonant structure or component, and "W" is the weight mass. Note that at the core of this formula is: Increased stiffness will therefore raise the natural frequency, and increased mass will lower it. Resonance is what happens when these two opposing forces are equal; they cancel each other out, allowing vibration to increase. The damping factor A third force, damping, is at work throughout the speed range. Damping absorbs vibratory energy, converting it to heat. In doing so, damping reduces the maximum amplitude of the vibration at resonance and increases the width of the amplification zone Figure 2. A common example of damping is shock absorbers on a vehicle. Machines with sleeve bearings may have significant damping that can even mask critical speeds. On machinery bases, concrete and grouting add significant damping to a base structure. These forces stiffness, mass and damping determine the characteristics of resonance and are important in the distinction between structural resonance and rotor critical speeds. With structural resonance, the machine is operating very close to a resonant frequency. It is most noticeable when damping is low, since very high vibration amplitude results. Solutions include changing the resonant frequency to move it away from the operating speed by modifying stiffness or mass and increasing damping to directly reduce the amplitude. The various methods for implementing these corrective measures are topics for another article. The objective here is a comparison to rotor critical speeds. With a rotor critical speed, the problem is quite different. First, the stiffness, mass and damping of rotors mounted on rolling element bearings can almost never be effectively changed, and damping is typically very low. Mounted rotor natural frequencies of large journal bearing machines typically can be changed to some degree by modifying the bearing dynamics. Second, no rotor is ever intentionally designed to have a critical speed close to its operating speed. The problem in this case is not that the operating speed is close to resonance, but that at the rotor critical speed the rotor distorts and non-linear effects cause excessive vibration. The sum of these unbalance forces can be corrected in any two planes with common two-plane dynamic balancing methods. In these rigid modes the rotor may flex slightly, but the motions at the bearings accurately represent the unbalance condition. However, once the rotor becomes flexible, above the first rotor critical speed, the distribution of unbalance forces will distort the rotor, causing an unbalanced condition that was not present in the rigid modes. This flexible mode unbalance causes increased vibration that persists at higher speeds. With structural resonance, the force is constant while the vibratory response of the structure changes with speed. With a rotor critical speed, the force changes as the rotor distorts to conform to unbalance forces distributed along the axis of the rotor. The solution to a rotor critical speed is to eliminate the unbalance forces in the various planes along the axis of the rotor. Usually it is not possible to detect where the unbalance forces are with the rotor in the rigid mode, so the rotor must be operated above the rotor critical speed in the flexible mode to detect the effects of the unbalance. Bending modes As the speed of a rotor increases it will go through a series of bending modes: Rotors for multistage pumps and gas and steam turbines may operate above the first or second rotor critical speed, and generators sometimes operate above the third rotor critical speed. Rotors for large, two-pole electric motors may operate above the first rotor critical speed but seldom above the second. These dynamic balancing procedures require the rotor to spin at operating speed, which can only be done safely with specially designed balancing machines in a spin pit. Alternately, the individual components of flexible rotors, such as impellers, can be balanced before assembly. Understanding the difference between structural resonance and rotor critical speeds will help clarify the discussion for maintenance and service personnel, especially when the topic is multistage pumps, turbines or large, two-pole motors.

3: Ford Mustang Driveshaft Problems

Tiro Dragi is the author of Collection of Solved Problems in Vibration (avg rating, 1 rating, 0 reviews, published).

Print One day you walk out in your plant or manufacturing facility and a pipe is vibrating. It is a relatively high-frequency vibration. What is your response? Maybe it is to put in new supports or just to leave it alone. However, you know from previous experience if the supports are not put in the correct locations and are stiff enough, they may make the problem worse. You also know any failure resulting from that effort has no basis involving proper engineering. Perhaps you might look at the problem in some detail from an engineering point of view. Piping vibrations due to pressure pulsation can come from many sources. One source is acoustical-driven pulsations due to reciprocating or centrifugal equipment in process systems. Other sources can originate from process dynamics. In order for the pipe to vibrate, several conditions must be satisfied. First of all, we know if a pipe is vibrating in a harmonic manner, there must be a corresponding driving force to cause the vibration. For pressure pulsations to vibrate a pipe, the pressure pulsations must match the natural frequency of the piping system. You might be asking yourself how or why the fluid is pulsating in the first place. Piping systems have acoustic natural frequencies. When pressure and flow fluctuations match the acoustic natural frequencies of the pipe, the fluid can resonate at different acoustic modes. It is usually but not always at higher modes. There you have it; the fluid fluctuations match the acoustic natural frequency, the fluid resonates, the resonating fluid matches the natural frequency of the pipe and vibration occurs. They want the right flow conditions to occur to make noise, which hopefully is pleasant, unless you have an 8-year-old practicing music. So how do you fix the problem? You must first determine if you have a problem. This can be accomplished by calculating the dynamic stresses in the piping system. If the dynamic stresses are too high, you need to do something. Some but not all options might be as follows: A metallurgical review should be conducted to characterize any fractures if the physical evidence is available. Conduct a field study to determine what the forcing functions are in the systems. Such a study would include but is not limited to dynamic pressure readings and vibration, along with the process conditions. It may also be that the study should include monitoring over several shifts to capture any transients. Eliminate the source of the pulsations. Sometimes process changes can be made to eliminate the problem. Perhaps a variable speed drive could be installed and the equipment could run at a different rpm revolutions per minute. Process changes are not always easy or practical. Add hardware to the piping system to eliminate the pulsations. The existing system must be analyzed to determine the acoustic natural frequencies and hardware added to the process, such as pulsation bottles. These can be suction stabilizers, discharge dampeners or Helmholtz resonators. These should be acoustically tuned to the entire system. Remember, minor modifications to the piping in the future could void this effort. Also, all details of the piping systems are important, such as drain valve stub-in. Adding support can sometimes solve the problem. It changes the mechanical natural frequency of the system. In other words, the supports might detune the system. However, adding supports can sometimes make the problem worse if it causes the system to respond at a harmful mode of vibration. A combination of all of the above. The next part of the problem is validating the fix, which is important for high-frequency problems. Pulsation frequency could be so high that cracking occurs in components like the pulsation equipment. Field data acquisition should be conducted to capture vibration and dynamic pressure to ensure the design is working. Solving a piping vibration problem due to pressure pulsations is not always a quick fix. These problems should be analyzed and reviewed by a professional engineer competent and experienced in these types of problems. For more information, visit www.

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4: | Consulting-Specifying Engineer

Collection Of Solved Problems In Vibration PDF Of Solved Problems In Vibration Collection of solved problems in vibration cbuddede, read collection of solved problems in vibration as one of your reading books, vibration problems in engineering.

Driveshaft problem of the Ford Mustang 2 Failure Date: The dealer service dept. Determined the problem was a faulty drive shaft and replaced it twice and indexed the second one after installation. The car still vibrates. The tires were road forced balanced and rotated and the vibration is still happening. This leads me and other professionals to conclude that there may be other malfunctioning parts or a possible design flaw in the drive line which I believe Ford motor company knows about. The vibration is felt through the car and the rear mirror image is blurred while driving. A Ford customer service rep. Has told me this vibration is "normal" and "no repair is needed". They refuse to investigate the cause further or fix this defect. I wonder, if it is normal why did they try to fix it twice. It appears this is a common problem with these cars or if they were designed so a vibration can shake your body while driving, as the customer service rep is implying, then the consumer should be made aware or notified of this vibration characteristic before purchasing. Note, that while the service dept. Was attempting to diagnose the problem the shop foreman told me he drove four new cars from their stock and found 3 of them to have this vibration defect. Now in my vehicle it appears that the vibration is causing the rear axle differential seal to start leaking. I would like to suggest that a investigation be started into this matter to determine the extent or number of vehicles that are experiencing this sensation. Regardless Ford motor company should be made to fix these defect on all vehicles affected or refund the consumers the purchased price of the vehicle if they cannot fix it. Driveshaft problem of the Ford Mustang 3 Failure Date: Whenever the contact shifted gears, a pinging metal sound was heard. The contact took the vehicle to the dealer where it was diagnosed that the drive shaft and the transmission failed and needed to be replaced. The vehicle was not repaired. The manufacturer was made aware of the failure. The approximate failure mileage was 1, Driveshaft problem of the Ford Mustang 4 Failure Date: It is felt through the whole vehicle, the steering wheel and seats. The dealership replaced the driveshaft, and the vibration is still present. The dealership believes the problem is axle related and asked for assistance from Ford. Ford acknowledged the issue, but did not offer a solution. The dealership believes it is a safety concern. Ford is still not addressing it. This is a safety concern that needs to be addressed.

5: Solving Vibration Analysis Problems Using MATLAB: R.V. Dukkipati: www.enganchecubano.com: Books

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A bucket with mass m 2 and a block with mass m 1 are hung on a pulley system. Find the magnitude of the acceleration *with which the bucket and the block are moving and the magnitude of the tension force T by which the rope is stressed.*

9: A pulley system â€” Collection of Solved Problems

An Analytical Approach to Solving Motor Vibration Problems utilizing the proper data collection and analysis techniques, To solve a vibration problem one must.

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