

quencies obtained from the analysis are in fairly good agreement with those obtained by the experiment.

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Vibration of Piping System by Pulsation of Containing Fluid (1st Report, Lateral Vibration of Piping Excited by Fluid Force)

Mamoru TANAKA and Katsuhisa FUJITA

An analytical estimation method is described for lateral vibration of piping system by the pulsation of containing fluid. The vibration of piping is considered as a forced vibration by the fluid force due to the pressure pulsation. The pulsating pressure and flow rate of containing fluid is estimated using the transfer matrix method. The vibration response of piping is then calculated utilizing model parameters of the piping vibration and the fluid force. The estimated responses on the pressure pulsation and piping vibration are compared with measured responses in both model piping system and actual high repressure pump delivery line and it is found that the presented analytical estimation method has reasonable accuracy for practical use.

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An Analysis of the Coupled Vibration of Liquid Containers Considering the Effects of the Compressibility of the Liquid

Masaaki TAKAYANAGI

An approximate method is proposed for the analysis of liquid containers considering the effects of the compressibility of the liquid. This method is based on the expansion of the vibration mode of compressible fluid-structure interaction using the coupled modes of incompressible fluid-structure system. Further simplified equations are derived assuming that the vibration modes are not changed when fluid compressibility is included. This paper also shows a technique to avoid the drawback of the mass matrix becoming the full

matrix when fluid-structure interaction is considered. It consists of solving simultaneous equations utilizing the sparsity of fluid stiffness matrix without composing the full matrix in the subspace interaction method for eigenvalues. Calculated natural frequencies and frequency response spectra, including compressibility of fluid, agree well with experimental results.

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Free Vibrations of Pre-twisted Plates (Numerical Results by Rayleigh-Ritz Method)

Tsuneo TSUJI, Kenji KANEKO and Teiyu SUEOKA

A numerical method to analyze the free vibration of a pre-twisted cantilever plate is presented in this paper. The method proposed is based on the Rayleigh-Ritz procedure. Frequency parameters and mode shapes of vibration for typical pre-twisted plates are computed and compared with results obtained by other investigators. The comparison shows that the method proposed is useful for analyzing the free vibration of pre-twisted cantilever plates. Then, the effect of pre-twist and the aspect ratio of plates on the free vibration is investigated.

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Influence of Damping on Squeal in Electromagnetic Friction Clutches and Brakes

Yutaka KURITA and Hiroshi IWAMOTO

This study presents experimental results and theoretical analysis of squeal in the two-disks system, which is modeled after actual clutches or brakes. The system consists of a disk clamped along the inner edge and freed along the outer edge and a disk freed along both edges. It was observed that damping is more effective on squeal in high order modes. Thus the squeal frequency becomes lower as damping is increased. No squeal is generated when damping of two disks is over a limit in a state plane.

To express the influence of damping on squeal theoretically, equations of motion with viscous damping terms are investigated and the characteristic equation is derived from them. Damping ratios of two disks have much effect on the squeal propensity which is a real part of the root of the characteristic equation.

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Technical Development of Radiated Noise Reduction Using Sensitivity Analysis

Ichiro HAGIWARA and Masamitsu YAOI

As engine block vibration contributes to engine noise, reducing the noise it radiates has become a major theme. Recently, radiated noise has been calculated on the basis of structural vibration data using BEM. Although there have been reports on radiated noise calculations, no literature reporting investigations of structural changes to reduce radiated noise has appeared. In this study, we investigated the basis of BEM to calculate radiated noise. We applied FEM to a rectangular panel model to analyze its vibrations. Using BEM we calculated the radiated noise from this vibration data. Next, in order to find a method for making structural changes, we applied the eigenmode sensitivity analysis method proposed by one of the authors. As a result we were able to reduce the noise pressure level radiating from the rectangular panel.

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An Analysis of Running Stability for High Speed Railway Vehicles Connected in Series with Elastic and Frictional Forces against Truck Turning (3rd Report, Stability Criteria for Vehicle Hunting)

Keiji YOKOSE and Isao NOMOTO

In this paper, we analysed theoretically the hunting stability of a high speed railway vehicle which has at least seven degrees of freedom with