introduced parameters. The results are discussed and graphically presented.

*Nagoya Institute of Technology, Nagoya, Showa-ku, Nagoya, 466, Japan
**Aichi Gakuin University, Aichi-gun, 470-01, Japan

Lateral Vibrations of a Rotating Shaft Driven by a Universal Joint (3rd Report, Vibrations Caused by Frictions between a Cross-Pin and Yokes)

by Hiroshi OTA and Masayoshi KATO The present investigation concerns lateral vibrations of a rotating shaft driven by a universal joint which has viscous and Coulomb's frictions.

Periodic forces are obtained when viscous and Coulomb's frictions act on the relative angular motion between a cross-pin and yokes of th universal joint, and the character of the vibrations is explained. The flexible driven shaft is supported by a universal joint at one end and a ball bearing at the other end. The driven shaft carries a balanced rotor. Analyses and experiments show that vibrations caused by viscous friction between the cross-pin and the yokes enlarge with an increase of the joint angle but can scarcely occur, and that vibrations caused by Coulomb's friction are independent of the joint angle.

Faculty of Engineering, Nagoya University, Chikusa-ku, Nagoya, 464, Japan

The Coupled oscillations of A Liquid and The Elastic Side Walls of A Rectangular Tank

by Masaru SAKATA, Koji KIMURA*, Masahiko UTSUMI** and Takeshi OKADA** The hydroelastically coupled oscillations of a liquid and the elastic side walls of a rectangular tank partially filled with a liquid, in response to the lateral excitation, are investigated. It is well-known that there are two types of liquid motion, i.e., sloshing and bulging.

In the present paper, the sloshing motion, in which the liquid surface oscillation may be of finite amplitude, is analyzed taking the nonlinearity into account. The time histories of the liquid surface displacement and the wall deformation are calculated to the harmonic, and earthquake excitations by the modal analysis approach. An experiment was conducted using a model tank, and the vibration responses of a liquid and the walls were measured. A good agreement was found between the theoretical and experimental results.

*Department of Physical Engineering, Tokyo Insitute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo, 152, Japan
**Ishikawajima-Harima Heavy Industries Co., Ltd. Kooto-ku, Tokyo, 135-91, Japan

Non-Linear Vibrations of a Beam Having Variable Cross Section Under Periodic Lateral Forces

by Ken-ichi NAGAI and Kazuya OTSUKI Theoretical analyses are presented for nolinear bending vibrations of a beam having variable cross sections subjected to periodic lateral forces, considering the effects of initial static deflection and axial displacement. By use of the Galerkin procedure, assuming the form function which is composed of the finite power series and the trigonometrical function, basic equations are reduced to coupled nonlinear ordinary differential equations. The steady state harmonic solution is obtained with the harmonic balance method. Numerical calcuations are carried out for the six degrees of freedom, nonlinear responses of principal, super-harmonic and subharmonic vibration are determined for various shapes of the beam, with initial deflection and axial displacement.

Especially, the characteristic features of the principal responses with the asymmetric mode of vibration are clarified.

College of Technology, Gunma University, Kiryu, Gunma, 376, Japan

An Analysis Method of Lateral Vibration of a Bogie-Car (Verification of the Linear Model Considering Contact-Force between the Wheel and Rail)

by Katsuya TANIFUJI In order to simulate the lateral vibration of bogie car easily, both in quality and in quantity, a calculation method was studied using a linear model which considered the contact force between the wheel and rail. The calculation results were compared with the data of a Shinkansen electric car obtained in a test running on an artificially set lateral alignment track irregularity.

As the result, it was made clear that the calculation did not coincide with the characteristics of real cars because of the large elasticity in truck turning. But, by decreasing the elasticity and restricting the wheelset excursion in the play between the flange and rail, the calculation results became similar to the features of real cars. It was also confirmed that decreasing the lateral elasticity of the secondary spring was effective in reducing of lateral vibration.

The Railway Technical Research Institute, JNR, 2-8-38, Hikari-cho, Kokubunji, 180, Japan

The Calculation of Diffracted Sound Field by Boundary Element Method

by Katsuo FUJITSUKA and Kohshi NISHIDA The diffracted sound field around a rectangular enclosure is computed by Boundary Element Method (BEM). In the computation, the field is analyzed by 2-dimensional BEM, by means of converting the distance-damping effect due to cylindrical wave into that due to spherical wave. The distribution of sound pressures around the enclosure is numerically evaluated by this method, and compared with experimental results obtained using a sound visualization device consisting of an electronic switch circuit system composed of three color-light emitting diodes, installed on a microphone, functioning to the magnitude of sound pressure level; a micro-