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Sixth World Conference on Earthquake Engineering, New Delhi, January 10-14, 1977

Vibration Analysis of Buildings in Consideration of the In-plane Deformation of Floor Slabs

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The vibration characteristics of buildings with long and narrow plans are influenced by the in-plane deformation of floor slabs. In the paper, soil-structure interaction is analyzed by using two-dimensionally distributed multi-mass models in order to obtain effective factors for in-plane deformation of slabs. These models are idealized by replacement of buildings and soils with multi-mass systems arranged in the vertical derection and the horizontal direction parallel to the long side of plans. Eigenvalues and response values of soil-structure systems are computed and discussed in the cases where a partial basement is laid at different positions in the whole plan of the building, where the soil formation under the site has a dislocation or consists of duplicated bias layers, and where the shape of floor plan is complicated. The relations between the maximum response and the direction of ground motion are also investigated.

VI-th World Conference on Earthquake Engineering, New Delhi, India, 10-14 Jan, 1977

Questionnaire Survey for an Estimation of Seismic Intensities and Microzoning Characteristics at Several Cities in Japan

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An estimation of seismic microzoning characteristics as well as seismic intensities at several cities in Japan was carried out by means of a questionnaire survey. A questionnaire sheet contains 34 questions; 9 of them are describing replier's circumstances, 21 questions relate to seismic intensities and so on. These questions are made to be more responsible to imperceptible differences of the quake than in the past. Soon after a moderate-to-large earthquake occurs thousands of questionnaire sheets are delivered to shocked areas. To date, 10 small-to-middle cities of which populations are from 50,000 to 1,000,000 were surveyed by use of 6 earthquakes.

72th Annual Meeting of the Seismological Society of America, Sacramento, USA, 5-7 April, 1977

Shear Wave Velocity Measurment in a Borehole to the Depth of 3,500 Meters

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A deep shear wave velocity logging was planned from an earthquake engineering point of view, and was actually carried out down to a depth of 3,500 m in the Tokyo area by a temporary use of a deep borehole constructed by National Research Center for Disaster Prevention of Japan.

Shear waves were produced mainly by means of ordinary small explosions in a shallow hole and supplementarily by a specially designed SH wave generator firmly pressed on the ground surface. A set of three component seismometers of moving coil type with natural frequency of 4.5 cps was installed in a capsule having a clamping device to the borehole wall at any depth. Repeated measurements were conducted at 17 different depths to the borehole bottom. The maximum distance to which the signal by means of the SH wave generator was clear, reached as deep as 1,000 m. Since comparisons were made into the depth of 1,500 m between two types of the employed seismic sources, the detection of shear events in the deeper measurements by simple detonations became unexpectedly easy.

The shear wave velocities beginning with 0.2 km/s at the ground surface increase with increasing depths, tracing an approximate parabolic curve. The obtained velocities at depths of 1,000, 2,000 and 3,000 m are 1.2, 1.5 and 2.4 km/s respectively, and the one way time to the bottom was 3.2 seconds.

72th Annual Meeting of the Seismological Society of America, Sacramento, USA, 5-7 April, 1977

Empirical Equation of Shear Wave Velocity in Terms of Characteristic Indexes of Soil

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An investigation to systematize empirical equations of shear wave velocity of soils was made in terms of four characteristic indexes. The adopted indexes are N-value of the Standerd Penetration Test, depth where the soil is situated, geological epoch, and soil types. As some of these are the variates belonging to interval scales while others are of nominal or ordinal scales, the common technique known as a conventional multivariate analysis cannot be employed. A new approach by the theory of quantification after C. Hayashi was introduced and developed for solving this difficulty.

The empirical equations to estimate shear wave velocity under low-strain conditions are theoretically possible up to 15 sets by combining the above four indexes. All sets of the equations were derived by use of about 300 data, and their accuracies were evaluated by means of the correlation coefficients between the measured and estimated shear wave velocities. The best equation is one which includes all the indexes, and its correlation coefficient is as high as 0.86. The empirical equation of the N-value to the shear wave velocity, which is well-known and commonly used because the standard penetration test is very popular in soil engineering, is only 0.72 in the correlation and is the one belonging to the low-ranking among the 15 sets of the equations.

VI-th World Conference on Earthquake Engineering, New Delhi, India, 10-14 Jan, 1977

An Investigation into Human Psychology and Behavior During an Earthquake

Yutaka OHTA* and Shun-ichiro OMOTE**

By carrying out questionnare surveys human psychology and behaviors in relation to seismic intensities were investigated. Special concerns were made to the people's general behavior and mental attitudes, attention to dealing with a

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fire source, and reactions of the people who happened to be driving a car during the quake. It was clearly confirmed that the human behavior and psychological conditions are strongly correlated to seismic intensities, that is, people's responses go from bad to worse with increasing intensities.

VI-th World Conference on Earthquake Engineering, New Delhi, India, 10-14 Jan, 1977

1-to 5-sec Microtremors and Their Application for Elucidating Natures of Strong Ground Motions

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An investigation of long-period ground motions by means of 1–5 sec microtremors is reported in this paper. At the Tokachi-oki earthquake of 1968 (M=7.9), in Hachinohe and Aomori of which epicentral distances were about 200 km, very large amplitudes in 2–3 sec period range appeared on the strong motion records of SMAC type accelerographs. In Miyako, although almost the same distance, there were no significant amplitudes in long-periods. To understand whether these differences are from source or site effects is very important for estimating input motions to high-rise buildings. A long-period microtremors observation was introduced as a new technique to pursue this difficult problem.

By the observation of long-period microtremors in the above typical SMAC sites it was shown that long-period microtremors and strong earthquake motions show good correspondences in presences of predominancy and in predominant periods. Thus we conclude that systematic observations of long-period microtremors provide much knowledge regarding deeper soil conditions through which the amplification characteristics of long-period strong motions in future earthquakes can be estimated.

VI-th World Conference on Earthquake Engineering, New Delhi, India, 10-14 Jan, 1977

An Easy-Capable and High-Precise Shear Wave Measurment by Means of the Standard Penetration Test

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An experiment was carried out to develop a new technique to measure shear wave velocity simultaneously with the standard penetration test. A three-component geophone was set on the ground surface near the borehole mouth and the generated waves were recorded for succesive depths of the penetration test. Signal amplitudes decrease with depths and go under the noise level at a certain depth. Hence, a simple process of stacking was employed by use of the advantage that the waveforms of signal events by N blows of the penetration at a depth are very similar. Shear wave velocities by this new method, N values by the standard penetration test and other soil indexes were compared. By this experiment it was clarified that an easy-capable and high-precise shear wave measurement can be introduced without any expert knowledge into the routine work together with the standard penetration test.

VI-th World Conference on Earthquake Engineering, New Delhi, India, 10-14 Jan, 1977

A Macrozoning Map of Japan on Amplification Characteristic of 1-10 sec Strong Ground Motions

Yutaka OHTA*, Hiroshi KAGAMI** and Shigeyuki OKADA***

A study of amplification characteristics of 1-10 sec strong ground motion is an urgent task, since dynamic earthquake-resistant research should cover recent very high-rise and large-scale structures. In this new situation well-known studies on ground amplification of which period is less than 1 sec are of little use. In

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this paper a macrozoning map on the amplification of long period seismic ground motions is presented by use of the data due to strong motion displacement seismographs with natural period of 6 sec, operating at about 100 local observatories on Japan Meteorological Agency. All the shallow and moderate-to-large earthquakes occurred in and around Japan in recent 15 years were used for analysis. Total number of earthquake was nearly 150.

The 4th International Clean Air Congress, 16-20 May, 1977, Tokyo

Statistical Properties of Sulfur Dioxide Concentrations at Continuous Monitoring Stations in Japan

R. INOUE, and Y, WATANABE

A mathematical model for estimating the properties of frequency distribution of air quality data was developed.

If the frequency distribution of the air pollutant concentration for a given averaging time S is assumed to follow a log-normal distribution, it is possible to calculate any percentile value of the cumulative frequency distribution by means of two factors, e. g. the arithmetic mean $\overline{C}$ and the geometric mean $\overline{C}gs$.

From the statistical analysis of sulfur oxides concentrations at continuous monitoring stations in Japan the authors found that $\overline{C}gs$ statistically have a linear relation with $\overline{C}$ as

$$\overline{C}gs = a_s\overline{C} + b_s \tag{1}$$

where a_s and b_s is the constant for a given averaging time S. Furthermore if the form of $\overline{C}gs$ could be determined as a function of S, it will be possible to predict all value of the so-called arrowhead chart for that pollutant concentrations.

The authors conducted the case study for the sulfur oxides concentrations observed several continuous monitoring stations in Japan, and found that $\overline{C}gs$ approximately follow a general law of the type

$$\overline{C}gs = \overline{C} - (\overline{C} - \overline{C}g)\left\{\frac{ln\, T/S}{lnT}\right\}^2 \tag{2}$$

where T is the sampling time and is one year (8,760 hours) in this case.

And

$$\overline{C}g = a\overline{C} + b \tag{3}$$

where a and b is the constant for one hour averaging time.

4th Internatinal Conference on the Strength of Metals and Alloys, Nanoy, France, 30 August-3 September, 1976

The Nature of Work-hardening of Aluminum Alloys Dispersion-hardened with Silicon Particles

Keisuke MATSUURA, Katsuyoshi AKABANE and Katsuya WATANABE

The single crystals of Al-0.6% and -1.2% Si alloys were aged under several conditions to contain silicon particles of various ranks of mean particle size (a few hundreds to a few thousands Å) and were put to tension and compression tests (Bauschinger test) at 77°K and the work-hardening behavior was examined.

The specimens of aged single crystal showed a pronouced Bauschinger effect while the ones quenched (solid solution state) did not. The mean internal stress which was estimated from the measurment of Bauschinger effect increased initially with a tensile strain that was applied prior to the compression test. This increase seemed in agreement with a theoretical internal stress due to Orowan loops around the silicon particles. The internal stress acounted for the most part of the work-hardening within a range of a few percent of strain. At a larger strain a plastic relaxation occurred by a generation of secondary dislocations which may eventually come to play an important role in the work-hardening. The contributions of the internal stress due to Orowan loops and the secondary dislocations were precisely examined and discussed.

Corrosion Research Conference of National Association of Corrosion Engineers, March 14-16, 1977, San Francisco, California, U.S.A.

Benzotriazole and Tolyltriazole as Corrosion Inhibitors for Copper and Brasses

Takenori NOTOYA* and George W. POLING**

Benzotriazole (BTA) and Tolyltriazole (TTA) are both effective corrosion inhibitors for copper and its alloys. Due to the similarity in their molecular structures, it has been generally assumed that the inhibiting action of TTA would be similar to that of the much studied BTA. However, marked dissimilarities are found. Protective films formed by these two inhibitors, used sparately and in combination, were studied using infrared multiple reflection-absorption spectro-

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scopy, electrochemical polarization techniques, corrosion tests, and scanning electron microscopy. Copper, 70/30 brass, and 60/40 brass were exposed to aerated 3% NaCl solutions at 25°C and at pH's varying from 3 to 6 with and without an inhibitor present. Metal specimens given inhibitor pretreatments were also exposed to uninhibited NaCl solutions to compare the performances of these two corrosion inhibitors. BTA has been found to be a "film-forming type inhibitor". Reaction product CuBTA films on either copper or brass normally ranged from 50 to 5,000 Å in average thickness. TTA appears to function as a "absorption-type inhibitor". Thick CuTTA films were never observed in the exposure conditions used in these tests. TTA was an effective inhibitor for copper and brasses as BTA in both acidic and near-neutral NaCl solutions. The combination of BTA plus TTA as an inhibitor package proved more protective than either inhibitor used alone. TTA was not as effective as BTA as a "pretreatment" for either copper or brass. Long lasting protection by an inhibitor pretreatment apparently requires formation of a thicker, more persistent film such as BTA forms. Combination of BTA and TTA suppressed the formation of very thick CuBTA films, yet provided improved protection. The authors concluded that these thinner films, less than 30 Å, must have fewer defects than CuBTA films formed by BTA alone.

Gordon Research Conference on Corrosion, July 12-16, 1976, New London, New Hampshire, U.S.A.

Surface Topography and the Corrosion Inhibition Mechanism for Copper and Alloys

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George W. POLING
Department of Mineral Engineering, University of British Columbia, Vancouver, B.C., Canada

Surface Topographies prior to and subsequent to test exposures were examined for both thin and thick copper benzotriazolate films formed on copper and copper alloys by scanning electron microscopy. The results indicate that corrosion initiates at defects and discontinuities in the protective multilayer films of Cu_2O/CuBTA. In the thin film region some structural differences appeared to be in relation to crystallographic orientation of the metal substrates and/or underlying oxide, while structures of thick CuBTA films on top of the oxides appeared to be less dependent on crystallographic orientation of the substrate crystals. Protection of brasses by pretreatment with combined inhibitors was also described.

CIMAC 12th International Congress on Combustion Engines, Tokyo, 22–26 May, 1977

The Relation Between Nitric Oxide Emission and Combustion Process in Diesel Engines

Tadashi MURAYAMA, Noboru MIYAMOTO, Shizuo SASAKI and Naoya KOJIMA

A mathematical model for nitric oxide formation in a cylinder was presented to estimate the nitric oxide emission in diesel exhaust gas. The rationality of this model was confirmed by comparing the calculated values and the experimental ones which were obtained under various conditions of engine operations.

On the other hand, the combustion rate curves of diesel engines were attempted to be formed by the combination of the premixed combustion portion and the diffusive combustion.

By using these combustion rate curves and the mathematical model for nitric oxide formation, an intensive relationship between nitric oxide emission and the combustion rate curves was clarified and an optimum form of the combustion rate curves to secure a lower nitric oxide emission in engines without any increase of noise emission or sacrifice of the thermal efficiency was also found.

Simulation of Systems, edited by L. Dekker, 8th AICA Congress, Delft, August 23–28, 1976

A Multiprocessor System for Fast On-line Simulation of Dynamical Systems

Shoichi KOYAMA and Ryoich MIURA

This paper proposes a multiprocessor system for an on-line simulation of continuous dynamical systems. The system is a high speed series-parallel DDA. It has a hierarchical control structure which can effectively control an array of processors to carry out analog-like computation for on-line real time use. The memory and bus structure used in this system enables processors in the array to make efficient intercommunication and provides the stroed interconnection scheme which makes the user free from tedious patching efforts. A discussion on the choice of an efficient numerical integration method is also given in this paper.

The 3rd International Meeting on Boron Chemistry, July 5-9, 1976, München and Ettal, F. R. G.

Novel Syntheses of Nitriles, Nitroalkanes, and Carboxylic Esters from Trialkylboranes by Electrochemical Method

Yuzuru TAKAHASHI, Masao TOKUDA, Mitsuomi ITOH and Akira SUZUKI

Previously, we reported our synthetic procedures of alkyl group coupling products and alkyl methyl ethers *via* electrochemical reactions of trialkylboranes. In the course of studies on organic synthesis using organoboranes by electrochemical method, we undertook studies on electrochemical reactions of trialkylboranes with acetonitrile, nitromethane, and ethyl acrylate in appropriate solvents containing tetraalkylammonium halide as the supporting electrolyte using two Pt plate electrodes. These reactions proceeded smoothly in the usual undivided cell to produce corresponding nitriles (Eq. 1), nitroalkanes (Eq. 2), and carboxylic esters (Eq. 3) in good yields, respectively.

$$R_3B + CH_3CN \xrightarrow[\text{Pt-Pt}]{R'_4NX} RCH_2CN \quad (1)$$

$$R_3B + CH_3NO_2 \xrightarrow[\text{Pt-Pt}]{R'_4NX} RCH_2NO_2 \quad (2)$$

$$R_3B + CH_2{=}CHCO_2Et \xrightarrow[\text{Pt-Pt}]{R'_4NX} RCH_2CH_2CO_2Et \quad (3)$$

The Sixth International Congress on Catalysis London, England, 12-16 July, 1976

Intermediate in the Oxidation of Ethylene over Silver Catalyst

M. KOBAYASHI, M. YAMAMOTO and H. KOBAYASHI
Department of Chemical Process Engineering

The mechanism of ethylene oxidation over silver catalyst was studied in detail by a transient response method at temperatures ranging from 80 to 160°C.

A stable adsorbed intermediate was found to exist on the surface during the reaction. The intermediate (In) was formed by the reaction between gaseous C_2H_4 and adsorbed oxygen, and it decomposed successively into the same amounts of CO_2 and H_2O by reacting with adsorbed oxygen without producing C_2H_4O. Estimated composition of (In) was C : H : O = 1 : 2 : 2. Since the transient response of the rate of CO_2 formation showed quite the same behavior with that of (In)

formation, it is concluded that (In) is the reaction intermediate through which CO_2 and H_2O are formed during the reaction.

The form of the adsorbed oxygen species involved in each elementary step was investigated by using O_2 and N_2O and it is concluded that C_2H_4O is formed by diatomic oxygen while (In) is formed by monoatomic oxygen and decomposed by diatomic oxygen.

Magnetic Resonance in Colloid and Interface Science, American Chemical Society Symposium, Centennial Meeting, San Francisco Aug. 30–Sept. 3, 1976

ESR Studies of Radicals Adsorbed on Zelites (Invited Lecture)

J. SOHMA and M. SHIOTANI

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ESR studies were carried out on methyl, ethyl, ammonia radicals trapped on zeolites, pre-heat-treated at various temperatures. Two differenet types of methyl radicals were found in addition to the normal methyl radical. One abnormal methyl radical showed a superhyperfine coupling with an extra proton. The other abnormal methyl radical has a stronger coupling with one proton among its three protons. It was also found that ethyl radical has a superhyperfine coupling with an extra proton. There are three types of the ammonia radicals trapped on the zeolites depending on the absorption conditions and the heat-treatment temperature range; the first one is unstable and mobile, the second one stable and less mobile and the third one has a superhyperfine coupling with a sodium ion in the zeolite. Molecular motions of these trapped radicals were studied from the temperature variations of their spectra and the activation energies were estimated for the rotational correlation times of these radicals. The natures of the various trapping sites of the heat-treated zeolites were discussed in connection with the behaviors of the trapped radicals.

Fourth International Symposium on Radiation Chemistry, Keszthely, Lake Balaton, Hungry, June 1–5, 1976

Spin Trapping of Radicals Formed in γ-Irradiated 2-Methyltetrahydrofuran

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Spin trapping technique with 2, 4, 6-tri-t-butylnitrosobenzene (BNB) was applied to identify the radical species produced by γ-radiolysis of 2-Methyltetrahydrofuran (MTHF) in liquid phase. ESR spectrum observed from the spin adduct was decomposed into the two components, the triple-triplet and the triple-quartet. The latter was ascribed to the radical species, in which the unparired electron exists at the carbon having the methyl group. The former component was attributed to the radical having an unpaired electron at the carbon with single hydrogen. Although there are four possible structures of the radical having single α-hydrogen, the most probable radical was that with the unpaired electron at the site 5 adjacent to the oxygen of MTHF.

The 27th Meeting of the International Society of Electrochemistry (I. S. E.), Zurich, Switzerland, Sept. 6–11, 1976

Effect of Cathodic Pretreatment on the Passivation of Iron in Neutral Solution

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H. KONNO and M. NAGAYAMA

Pure iron specimens anodically oxidized at +600 mV (vs. SCE) for one minute were partially reduced with a cathodic current of 10 μA/cm^2 and then reoxidized at the same potential for one hour. The experiment was performed in a boric acid/borate buffer solution at pH=8.43 at room temperature. Variation in the thickness of the oxide film during the experiment is dicussed for an inner Fe_3O_4 and outher γ-Fe_2O_3 layers, with emphasis on the effect of cathodic treatment. In the discussion, the amounts of charge for anodic and cathodic processes and the amount of dissolved Fe^{2+} ions during cathodic reduction are utilized.

The 17th Corrosion Science Symposium, Leeds, England, Sept. 22-24, 1976

Effect of Anions on the Oxygenation of Ferrous Ion in Neutral Solutions

H. TAMSUA, K. GOTO and M. NAGAYAMA

The rate of oxygenation of ferrous ion was measured in neutral and slightly acidic solutions containing various anions. The reaction proceeded according to $-d(Fe^{II})/dt = k(Fe^{II})(O_2)(OH^-)^2$ in solutions of ClO_4^-, NO_3^-, Cl^-, $H_3SiO_4^-$, Br^-, I^- and SO_4^{2-}, the rate constant, k, decreasing in the order of anions as arranged above. Anions such as F^- and $H_2PO_4^-$ were found to accelerate the reaction remarkably. The rate equations obtained were $-d(Fe^{II})/dt = k_F(Fe^{II})(O_2)(OH^-)(F^-)^2$ and $-d(Fe^{II})/dt = k_P(Fe^{II})(O_2)(OH^-)(H_2PO_4^-)^n$. The value of n was 1 or 2 depending upon the concentration of the anion. The role of the respective anions in the oxygenation was explained by assuming that the complex of the anion with ferrous ion constitutes the reacting species. The type of rate equation was shown to be determined by the competition of the complex with $FeOH^+$ for O_2OH^-, the dissociated species of hydrated oxygen.

The 27th Meeting of the International Society of Electrochemistry (I. S. E.), Zurich, Switzerland, Sept. 6-11, 1976

Electrochemical Behaviour and Structure of Anodic Oxide Films Formed on Alminium in a Neutrai Borate Solution

H. TAKAHASHI and M. NAGAYAMA

99.99% Al specimens were anodically oxidized in a boric acid-borate solution (pH=7.4) at temperatures of 20°, 40° and 60°C, by applying a constant potential of 50 V (vs. SCE). The anodic current and the amount of dissolved Al ions were measured as a function of the anodizing time. Observations of sections of the oxide films were made by electron microscopy using an ultra-microtome for sample preparation. The current was found to decrease exponetially with time to a steady value which is higher for higher temperatures. The current efficiency for the formation of oxide decreases gradually with decreasing current and is less than 70% in the period with steady current. The low efficiency of the reaction is exclusively due to the field-assisted dissolution of the oxide. In general, the oxide film is composed of two layers. The inner layer next to the metal is compact

and is responsible for the polarization behaviour, its thickness being almost constant during anodizing but increasing with decreasing solution temperature. The outer layer, on the other hand, has many vertical pores and continues to grow even in the period with steady current. The porosity of the outer layer is estimated to be 22% for 40° and 60° films and 60° film contains about 5% bound water. The corrent-potential relationships measured for the anodized specimens in a 20° solution indicate that the protective ability of the inner layer increases with increasing anodizing time and temperature.

15th International Conference on Coastal Engineering, July 11-17, 1976, Honolulu, Hawaii, U.S.A.

Tidal Response of Two-Layer Flow at *A* River Mouth

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This paper describes various features of tidal effects on the behavior of a salt wedge and on the mechanism of mixing between the salt water and the fresh water in the vicinty of a river mouth. The studies were performed through experiments, field observations and theoretical considerations.

The condition upon which the fresh water begins to show an intermittent flow-pattern owing to an increase of the tidal action, and the criterion of a transition of the mixing type from negligible into intense, was obtained with two dimensionless parameters λ, θ. The former parameter λ is given by $\lambda=A_0/U_0T_0$, in which T_0 is the tidal period, A_0 is the tidal amplitude of the sea level, and U_0 is the temporal mean velocity of the fresh water at the river mouth. The latter parameter θ is the so-called Keulegan number.

Besides, it became evident that a tidal motion of the salt wedge could not be understood without a consideration of the interfacial waves inside the river mouth, which were induced by the tide, in addition to the direct effect of the tide.