－Priority Research Project－

Research on economical seismic retrofit technologies for civil infrastructures

Research Period: FY2002-2005
Project Leader: Director of Earthquake Disaster Prevention Research Group
MATSUO Osamu
Research Group: Earthquake Disaster Prevention Research Group

Abstract:
Seismic retrofitting of existing civil infrastructures is often very costly due to construction of false works or use of special construction equipments. In addition, use of insufficient seismic assessment method may increase the amount of structures to be retrofitted. The research project aims at developing more reasonable seismic assessment methodologies and more cost-effective seismic retrofitting technologies, thus reducing the total cost of seismic strengthening of existing infrastructures. The objective structures in this research project include road bridges, earth embankments and sewage collecting underground pipes.

Main results and findings obtained in fiscal year 2004 are given in the below.

1) For low-rise wall-type bridge piers which generally show the deep beam effect against shear bearing capacity in transversal direction, the deep beam effect may be taken into account up to a response ductility ratio of around 1.5.

2) Seismic assessment method and retrofitting technologies for bridge piers were improved by considering that abutments restrict the range of seismic response displacement of girders.

3) A displacement-based seismic design procedure was developed for foundation soil improvements that support retaining walls on liquefiable sandy ground.

4) Embedment of geotextiles in earth embankments reduce differential settlement during earthquakes.

5) Uplift movement of underground pipes due to liquefaction of backfill soils can be significantly reduced by using backfill soils mixed with small amount of cement

Key words: seismic retrofitting, existing civil infrastructures, seismic assessment method

－Individual Themes－

Research on seismic retrofit measures based on the performance of total bridge system

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Earthquake Engineering
Author: UNJOH Shigeki
KOBAYASHI Hiroshi

Abstract:
After the 1995 Kobe earthquake, the usual seismic retrofit method is found difficult Abstr act to apply for bridges including river bridges and mid to long span bridges because of the strict construction condition and also economical reasons. Therefore the development of cost-effective seismic retrofit method is required.

The objective of this study is to develop the seismic retrofit measures considering the performance of total bridge systems, which do not require the strengthening of each member such as substructures. Experimental and analytical study to improve the evaluation method of the shear strength of RC wall type columns, which is a dominant design issue on seismic evaluation of this type of columns, was carried out. Then, a seismic design procedure which limits the displacement response of whole bridge systems with abutment is proposed and some methods are introduced. It should be noted that "The examples of the seismic retrofit methods for existing bridges" based on this study is published. Furthermore, a survey analysis study on relation between damage of bearings, SI factor on the ground, type of bearings, and seismic coefficient of the columns is conducted in order to develop the reliability design method for seismic safety check.

Key words: existing bridges, total bridge system, shear capacity, deep beam, abutment, "The examples of the seismic retrofit methods for existing bridges", damage survey analysis

Improvement of seismic remediation technique for river dike founded on liquefiable soil

Budged: Grants for operating expenses
River account
Research Period: FY2000-2005
Research Team: Ground Vibration
Author: SUGITA Hideki
TAKAHASHI Akihiro
ISHIHARA Masanori
TANIMOTO Shunsuke

Abstract:
The purpose of this research is to improve a design method of seismic remediation technique for river dike founded on liquefiable soil. In fiscal year 2003, we conducted a series of centrifuge mode tests concerned with super levee on liquefiable deposit and showed that seismic resistance improvement of both ends of the embankment and partially ground improvement under gentle slope are effective to remedy seismic deformation of super levee.

In fiscal year 2004, a series of dynamic centrifuge model tests were performed in order to investigate seismic of retaining wall at the protected-lowland-side end of embankment and to propose a prediction method of residual displacement of the wall. As a result, we obtained the followings: 1)Prediction method applying Newmark method can estimate influences of height of wall, widths of ground improvement and thickness of liquefiable layer. 2)The prediction method should be modified to estimate influence of intensity of input motion. 3)Settlement of backfill and lateral displacement of embankment can be calculated from lateral displacement at the top of the retaining wall.

A prediction method of seismic displacement of retaining wall will be proposed.

Key words: ground improvement, super levee, centrifuge, liquefaction

A study on seismic countermeasure techniques of road embankment on liquefiable ground

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Ground Vibration
Author: SUGITA Hideki
SASAKI Tetsuya
ISHIHARA Masanori

Abstract:
Improvement of earthquake resistance of earth structures, for example embankment, has been required since the 1995 Hyogoken-Nanbu earthquake. The purpose of the study is to propose a rational and economical design method of seismic countermeasures. In FY 2004, a series of centrifuge model tests performed in order to investigate deformation mechanisms of road embankments and underlying liquefiable soils and the effects of seismic countermeasures to reduce liquefaction-induced embankment settlement. As a result,
1) A simplified method to predict embankment subsidence based on the deformation mechanisms was proposed.
2) Reinforced embankments resist to deformation of liquefied layer.
3) Effect of each countermeasure and synergy effects of some different countermeasures were cleared.

Key word: road embankment, earthquake, liquefaction, countermeasure, centrifuge model test

Study on efficient sewer development considering risk management

Budged: Income from entrusted research
(expectation)
Research Period: FY2003-2006
Research Team: Ground Vibration
Author: SUGITA Hideki
SASAKI Tetsuya
ISHIHARA Masanori

Abstract:
Sewage pipes were damaged by Tokachi-Oki earthquake in 2004 and Niigataken-Tyuetsu earthquake in 2005. In fiscal year 2004, factors that caused the sewage pipe damages were investigated and effects of countermeasures were confirmed. Surveys at sites where sewage systems were damaged by these earthquakes and laboratory tests of backfill materials were conducted to investigate characteristics of backfill. As the result, densifications of the backfill at more serious damaged area was smaller. Most liquefaction resistances was smaller than 0.2, the backfills were easy to be liquefied.

Then, a series of dynamic centrifuge model tests was performed. In the tests soft elastic rubber that has similar Young's modulus to soft clay and peat was used as original ground to investigate mechanism that many sewage pipes where peat layer exists were damaged, and cement mixed sand and gravels were used as backfill to confirm effects of countermeasures. As the results, we proposed hypothesis of the mechanism of many damages at the peat ground. The more loose backfill and the larger shear strain amplitude of original ground at the same depth of the pipe, the larger uplift displacement of the pipe became. And, effect of cement mixed sand and gravels was confirmed.

We will study prediction method of unequal settling due to earthquake between water treatment tank and connecting pipe.

Key words: earthquake, sewage systems, backfill, liquefaction, uplift displacement, countermeasure, centrifuge

－Priority Research Project－

Research on developing techniques for mitigating damage by debris flow and slope collapse

Research Period: FY2002-2005
Project Leader: Director of Erosion and Sediment Control Research Group
NISHIMOTO Haruo
Research Group: Material and Geotechnical Engineering Research Group
Erosion and Sediment Control Research Group
Niigata Experimental Laboratory

Abstract:
Recently, damages to houses and roads by debris flows, landslides and rock falls has occurred frequently, caused by torrential rainfalls, earthquakes, and eruptions of volcanoes. It is the social demand to reduce the damages by means of improving disaster-prevention techniques. Studies on developing the techniques to monitor slopes using new techniques such as GIS and IT, to prepare hazard map, and to design countermeasure works efficiently and in low cost, are being conducted.

Key words: debris flows, landslides, rock falls

－Individual Themes－

Development of risk management technique using hazard map for road slope disaster prevention

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Geology
Author: SASAKI Yasuhito
ANAN Syuji
YAJIMA Yoshinori

Abstract:
A hazard map that plainly displays the kind and degree of danger for the road slopes is required in examining the priority of the implementation of countermeasures. To establish a slope hazard management technique, we carried out a case study of hazard mapping in four different areas, fragility analysis of failure area in Niigata disaster area caused by heavy rain in July 2004, develop a hazard area estimation programs based on land slide simulation using GIS system.

key words: road slope, hazard map, fragility, hazard area estimation

Development of road slope evaluation techniques using road disaster prevention map

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2007
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
KON Yoshiaki
KATOU Shunji

Abstract:
In this study, in order to explore the direction for studies in the field of road disaster prevention, we carried out activities such as the establishment of road disaster database, analysis of road disasters, analysis of the standard rainfalls at precautionary closure sections, study on defects in road management, study on advanced techniques and systems for road disaster prevention in foreign countries and so on.

Key words: Road disaster prevention map, slope disaster, precautionary closure section, defects in road management, risk management

Research on the advanced technology for road slopes monitoring and stability evaluation

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
KON Yoshiaki
KATOU Shunji

Abstract:
This study carries out the development of road slope monitoring system with optical fiber sensor and the stability evaluation. By the model experiment on water retention feature of the soil and field test on optical fiber sensor, the evaluation method of slope failure was examined.

Key words: road slope, monitoring, optical fiber sensor, stability evaluation

Study on survey technique and hazard mapping for rockmass slope failure

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Geology
Author: SASAKI Yasuhito
KURAHASHI Toshiyuki
YAJIMA Yoshinori

Abstract:
This study describes survey technique and hazard mapping to reveal fracture distribution and delineate feature for rockmass slope failure. First, seismic tomography delineated fracture distribution as a low velocity part inside of the rockmass. Second, 3-D laser mirror scanner and GIS software precisely delineated slope feature for hazard mapping.

Key words: rockmass slope, seismic tomography, 3-D laser mirror scanner, GIS software

Study on the investigation, mesurement and hazard evaluation technique of rock slope (2)

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Landslide
Author: FUJISAWA Kazunori
ASAI Kenichi

Abstract:
This study is examining the methods for identifying unstable blocks by measuring micro-tremors and vibration on a rock slope. In 2004, results of vibration measurement at a rock slope near the road were analyzed. A result of analysis suggests that some blocks vibrate separately as micro blocks by the cracks, and re-observation of rock slope revealed some cracks separating the blocks into several micro blocks. It suggests that the vibration measurement will be one useful method to estimate the independent rock blocks.

Key words: rock slope, micro-tremors, vibration

Study on the evaluation method of the potential of lahar at the volcanically disturbed watersheds

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: Volcano and Debris Flow
Author: SASAHARA Katsuo
YAMAKOSHI Takao

Abstract:
A purpose of the study is to propose the evaluation method of the potential of lahar at the volcanically disturbed watersheds, which is based on the evaluation method of the hydrograph of lahar and the estimation method of sediment volume followed by studying hydrologic and erosional conditions at the watersheds influenced by tephra. In the F.Y. 2004, the integrated basin-wide prediction model of water and sediment discharge begins to be developed. This model includes the infiltration model which has been developed in the last fiscal year. Here, the calculation result of water discharge at the exit of the study basin is examined by the actual hydrograph obtained at the study basin in the Miyakejima Island.

Key words: volcanic eruption, lahar, Miyakejima Island, volcanic ash, basin-wide prediction model, infiltration model

A study on the improvement of simulation model and hazard map for mudflow

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: Volcano and Debris Flow
Author: SASAHARA Katsuo
TANAKA Hidemoto
YAMAKOSHI Takao
MIGUMO Yoshihiro

Abstract:
Warning and evacuation system should be established to mitigate the disaster by mudflow. Also, hazard area of mudflow inundation should be estimated. But, it is difficult to identify those area accurately in urban area, since the mechanism of mudflow inundation in urban area is complicated under the influence of structures such as buildings, roads.

In the physical year of 2004, numerical experiment was conducted to make the simulation model of sedimentation and inundation accurate by using unstructured grid.

Key words: mudflow inundation, sedimentation, numerical experiment, structured grid, unstructured grid

A study on landslide extraction method

Budged: Grants for operating expenses
River account
Research Period: FY2003-2005
Research Team: Landslide
Author: FUJISAWA Kazunori
NOMURA Yasuhiro
ISHII Yasuo

Abstract:
Currently, landslide risk has been evaluated by potential landslide site investigation. This investigation is implemented by check list method which determines investigation items and each items' allocation of marks. By applying multivariate analysis to landslide records and potential landslide site investigation results of Himekawa area, Nagano and Motoyama area, Kochi, we calculated each investigation items' relativity to actual landslide events. We improved the allocation of marks between items, based on the results. As a consequence, in Himekawa the evaluation accuracy was improved by decreasing the marks of "landslide history" and "landslide sign" items which are overwhelming in the existing method. On the other hand, in Motoyama area evaluation accuracy was improved by enhancing those items' marks more over. As a result of this study, it turned out that landslide risk cannot be evaluated by the existing uniform approach throughout the nation and it is necessary to improve the allocation of marks between the items according to the regional characteristics.

Key words: landslide, risk assessment, multivariate analysis, potential landslide site

A study on pile works design for landslide countermeasure

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: Landslide
Author: FUJISAWA Kazunori
ISHII Yasuo

Abstract:
Although some design formulas for pile works are proposed according to foundation conditions etc., the selection method which should be considered the modulus of deformation of landslide soil mass and pile bending stiffness is not proposed yet in the design formula of a landslide pile works. In this study, the application conditions of the design formula of landslide pile are clarified from a modulus of deformation of landslide soil mass and pile bending stiffness, and design method of landslide pile by FEM. It was clarified FEM analysis model created last year was proper to simulate the real landslide pile bending. Centrifuge model experiment was carried out to clarify influence of pile interval for failure of earth among the piles.

As a result of experiment, active failure occurred when the pile interval becomes wide.

Key words: landslide, pile works, Finite Element Method, modulus of deformation, bending stiffness

Investigation of landslide movement by optical fiber sensor

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: Niigata Experimental Laboratory
Author: HANAOKA Masaaki
MARUYAMA Kiyoteru
YOSHIDA Katsumi
KOJIMA Shin-ichi

Abstract:
The purpose of this research is to propose how to research the movement of the landslide by using the optical fiber sensor. So, the structure of the optical fiber sensor which the displacement of the large expansion and contraction can measure was devised in 2002. The research to put a sensor to practical use has been carried out from 2003. The sensor of the high performance which the optical fiber of the little modulus of elasticity was used for was developed, and the examination to put a sensor to practical use was enforced in the landslide slope in 2004.

Key word: optical fiber sensor, landslide movement investigation

－Priority Research Project－

Study on evaluation of water quality risk in water environment

Research Period: FY2001-2005
Project Leader: Reader of Water Quality Research Team
SUZUKI Yutaka
Research Group: Water Environment Research Group
Material and Geotechnical Engineering
Research Group

Abstract:
Water pollution with chemical micro-pollutants and pathogens has the possibility of damaging both human health and natural ecosystem. It is required, therefore, to clarify the status and the sources of the pollution described above, evaluate the influence of the pollution, prepare decision making procedures whether to take countermeasures, and where necessary, implement the countermeasures.

Four research targets are formulated in this study;
1) clarification of the fates of endocrine disrupting compounds (EDCs) and dioxins in water environment and development of comprehensive indicators for evaluating hormone effect
2) development of simple and easy methods for measuring EDCs and dioxins
3) clarification of the influence of EDCs on fish and the effect of wastewater treatment on EDCs removal
4) development of pathogen risk assessment methods for biosolids and wastewater reuse

In 2004, following researches were carried out.
1) Analytical techniques of the conjugated forms of natural estrogens in wastewater were improved by modifying the pretreatment method of samples. To clarify the distribution of nonylphenol and its derivatives (NPs) in a lake, surveys were conducted, and a simulation model which describes the fate of NPs in the lake was developed. Furthermore, decomposition rates of estrogen in water and sediment were obtained in a reservoir.
2) Three pre-treatment procedures for removing cross-reacting and/or disturbing substances in measuring 17ß-estradiol (E2) and estrone (E1) with ELISA method were compared. The result indicates that it is effective to remove humic-acid fraction in improving the accuracy of measuring E1 in influent.
3) On-site fish exposure systems were set at Water Quality Monitoring Stations along River Tama, and feminization effect of the river water was evaluated using hepatic

vitellogenin in male medaka as the indicator. The induction of vitellogenin coincided with the occurrence of the estrogenic activity of the river waters, which indicated the discharge from wastewater treatment plants caused the feminization of the male medaka.

4) The adaptability of cell culture of Cryptosporidium followed by the microscope observation or ELISA methods for the evaluation of its infectivity was investigated, which proved that the cell culture method was faster in comparison with mice infectivity test. However, the values obtained from the cell culture method were fluctuated, and improvement of measurement accuracy is necessary. As for virus detection, cellulose adsorbed coagulation and polyethylene glycol methods were investigated for concentrating viruses, and suitable methods for influent, effluent and tertiary effluent were proposed. With the concentration method and real-time PCR, Norovirus concentration in the activated sludge process was measured, and the removal efficiency of the process was obtained.

Key words: endocrine disrupting compounds (EDCs), pathogen, fate, measurement, water environment, wastewater treatment

－Individual Themes－

Behavior of chemicals from urban discharge in water environment

Budged: Grants for operating expenses
General account
Research Period: FY2001-2005
Research Team: Water Quality
Author: SUZUKI Yutaka
KOMORI Koya
TSUMORI Jun

Abstract:
The target substances of this study are endocrine disruptors (EDs) such as decomposition by-product of surface active chemicals and human and animal related hormones originating from urban wastewater, and the aims of this study are development of efficient investigation and analytical techniques of EDs in river water and sediment samples and the clarification of fate of EDs in water environment.

In FY 2004, we conducted development of analytical techniques of the conjugated forms of natural estrogens in wastewater treatment plants, surveys of concentrations of nonylphenol and its derivatives (NPs) in water and sediment samples in a lake, development of simulation model of NPs based on the surveys, and evaluation of estrogen decomposition rates of water and sediment samples in a reservoir. Then, following results were obtained.

1) We modified the analytical method of the conjugated forms of estrogens that we reported last year. The recovery efficiencies of conjugated estrogens (i.e., E1-S, E2-S, E3-S, E1-G, E2-G, E3-G and E2-S&G) were improved, showing 87 - 120% for secondary effluent and 60-110% for wastewater influent.

2) NPs concentration of the water samples in the lake decreased along flow direction, but that of the sediment samples showed opposite tendency. A simulation model was developed incorporating decomposition rates and adsorption constants obtained from experiments, and the model could calculate the characteristics of NPs composition and distribution of the water samples.

3) Decomposition rates of E2 were larger in the surface layer sediments or under aerobic condition than in the middle and bottom layer sediments or under anaerobic condition. If the decomposition rates were evaluated per unit mass of SS, the rates were high in the water samples than in the sediment samples.

Key words: NP, NPEO, NPEC, estrogens, river water, sediment, behavior, biodegradation

Research on evaluation of trace chemicals at wastewater treatment plants

Budged: Income from entrusted research
(expectation)
Research Period: FY2001-2005
Research Team: Water Quality
Author: SUZUKI Yutaka
KOMORI Koya
OKAYASU Yuji

Abstract:
Previous studies have pointed out the occurrence of many trace chemicals such as endocrine disrupting chemicals (EDCs) in sewage. Therefore, the method to estimate their fate and risk should be established.

In FY2004, improvement of EDCs measurement with ELISA method was studied, and behavior of free estrogen, their conjugates and synthetic estrogen (oral contraceptive pill) in wastewater treatment plants was investigated.

Main results are as follows;

1) Three pre-treatment procedures for removing cross-reacting and/or disturbing substances in measuring 17□-estradiol (E2) and estrone (E1) with ELISA method were compared. The result indicates that it is effective to remove humic-acid fraction in improving the accuracy of measuring E1 in influent.

2) Behavior of free estrogens and estrogen sulfates in a wastewater treatment process was studied under aerobic condition (MLDO>5mg/L) and long SRT (60 days) using a membrane bioreactor. Free estrogens were completely removed, while estrogen sulfates were decreased to some extent and remained in the secondary effluent. This result indicates that estrogen sulfates are much more persistent than free estrogens.

3) The occurrence of ethinyl estradiol (EE2), which is main component of an oral contraceptive pill, in influent and secondary effluent in 10 municipal wastewater treatment plants were studied. EE2 was detected by both analytical methods (HR-GC/MS and LC/MS/MS) and ELISA method. Concentrations of EE2 in influent were under detection limit and those in secondary effluent ranged from n.d. to 0.28ng/L.

Key words: endocrine disrupting chemical, estrogen, estrogen sulfate, ethinyl estradiol, ELISA, municipal wastewater treatment

Effects of estrogen-like substances in urban wastewater on fish and their indication

Budged: competitive fund
Research Period: FY2002-2005
Research Team: Water Quality
Author: SUZUKI Yutaka
MIYAJIMA Kiyoshi

Abstract:
Estrogen-like substances have been suspected to cause the feminization of wild fish in some rivers in Japan. To elucidate the influence of estrogen-like substances on fish in the rivers, we have developed an on-site fish exposure system using medaka Oryzias latipes. We placed two sets of the systems in two Water Quality Monitoring Stations (WQMSs) along the River Tama. Adult male medaka were exposed to the river water in a glass exposure tank. After 2-week exposure, hepatic vitellogenin concentration of each male medaka was measured. At the WQMS that is located the downstream in this study field and where eight sewage treatment plant (STP) discharges are received, all the male medaka were found to produce vitellogenin. Estrogenic activity derived from the STP discharge was thought to cause the feminization of the male medaka, which is supported by the following facts: the induction of vitellogenin of the male medaka coincided with the occurrence of the estrogenic activity of the river waters; the increase in estrogenic activity coincided with the increase in electric conductivity of the river water, which suggests the increase in the ratio of STP discharge to the river water.

Key words: estrogen-like substances, sewage treatment plant discharge, medaka, feminization, on-site fish exposure system

Study on techniques for identifying pathogenic microorganisms and analyzing their behavior

Budged: Grants for operating expenses
General account
Research Period: FY1999-2005
Research Team: Recycling
Author: OZAKI Masaaki
SUWA Mamoru

Abstract:
The aim of this study is to develop rapid and highly sensitive methods for detecting trace levels of pathogenic microorganisms (such as Norovirus and Cryptosporidium) in natural water, treated wastewater and sludge, mainly by adapting techniques of molecular biology (particularly the Polymerase Chain Reaction method). This study also aims to clarify the behavior of pathogenic microorganisms in wastewater treatment processes and in the environment, using the detection methods developed.

In FY 2004, we investigated the adaptability of cell culture of Cryptosporidium followed by the microscope observation or ELISA method for the evaluation of its infectivity. As a result, the cell culture method with the microscope observation or ELISA is faster in comparison with mice infectivity test. However, the values obtained from the cell culture method were fluctuated, and improvement of measurement accuracy is necessary.

As for virus detection, cellulose adsorbed coagulation and polyethylene glycol methods were investigated for concentrating viruses, and suitable methods for influent, effluent and tertiary effluent were proposed. With the concentration method and real-time PCR, we measured Norovirus concentration in the activated sludge process, and the removal efficiency of the process was obtained.

Key words: Polymerase Chain Reaction method, cell culture, Cryptosporidium, Norovirus

－Priority Research Project－

Research on techniques for conserving ground environment

Research Period: FY2001-2005
Project Leader: Director of Material and Geotechnical Engineering Research Group
KAWANO Hirotaka
Research Group: Material and Geotechnical Engineering Research Group

Abstract:
This study aims to 1) evaluate the environmental safety of construction materials, including natural rocks and soils, and various kinds of reclaimed materials from waste, and 2) develop effective countermeasures against ground contamination that is sometimes encountered at construction sites. The movement characteristics of toxic substances, such as heavy metals, organic chlorine compounds and dioxins are investigated. Methods for controlling contaminants are being developed as a tentative approach by integrating surveying, analyzing and monitoring.

Key words: environmental safety, construction materials, reclaimed materials

－Individual Themes－

A study on environmental safety of construction materials (1)

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Advanced Materials
Author: NISHIZAKI Itaru
MORIYA Susumu

Abstract:
This research aims to clarify environmental safety of construction materials.

Therefore, we experimented on behavior of solved the environmental endocrine disruptors from the ground material used by the public works.

Moreover, the adsorption and desorption experiment with the soil of solved-out environmental endocrine disruptors was done.

Key words: environmental safety, environmental endocrine disruptors, solve-out, adsorption, desorption

Research on environmental safety of construction materials

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
MORI Hirotoshi

Abstract:
An evaluation method for soil materials is essential to ensure environmental safety of construction material. In this research, we tried to grasp an environmental effect of hexavalent chromium leached from cement treated soil. In physical year 2004, we carried out experiments to clear tendency in leakage of hexavalent chromium from cement treated volcanic ash soil.

From the experiments, it was confirmed as follows;

1) Portland cement and cement type stabilizing agent has higher tendency to leach hexavalent chromium than portland blast furnace slag cement and new type cement.

2) Allophane in volcanic ash soil has no relationship with leakage of hexavalent chromium.

3) Leakage of hexavalent chromium reduces as curing period grows.

Key words: cement treated soil, hexavalent chromium, leaching, volcanic ash soil

Development of an evaluation method for heavy metal pollution caused by specific rocks

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Geology
Author: SASAKI Yasuhito
ANAN Syuji
ITO Masami

Abstract:
To establish the evaluation method regarding exudation of heavy metals from specific rocks, we carried out some leaching tests by various conditions, X -ray fluorescence spectrometric analysis, and the chemical composition analysis for some muck samples. The result showed that elution rates of heavy metals are related to type of acid, acidity of solvent and character of the element, and the content of sulfur and calcium indicate the potential of acidification due to oxidation of pyrite. The X-ray fluorescence spectrometric analysis can be applied as a simplified method to evaluate the oral toxicity of muck.

key words: muck, heavy metals, leaching test, X-ray fluorescence spectrometric analysis

Development of management method for soil and groundwater contamination in construction works

Budged: Grants for operating expenses
River account
Road account
Research Period: FY2002-2005
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
FURUMOTO Kazushi
MORI Hirotoshi

Abstract:
There are soil and groundwater contamination in some construction sites. A permanent countermeasure, such as decontamination, is desirable, however, from time and economical reasons, the interim remediation method is more suitable practically. The purpose of this research is to develop the impact forecast method, the remediation method and the monitoring method in order to make a suggestion of the interim remediation method.. In 2004, the tank-leaching experiments were carried out in order to develop the advective-diffusion transport model as the impact forecast method.

From these experiments, it was confirmed as follows,

1) By using the concept of the "conversion leakage depth", the process of expansion of leakage area in the soil block is simulated approximately.

2) The evaluation method of the concentration of the toxic substance in the transport model is proposed with above concept.

From now on, revision of a manual will be due with the field investigations and survey the trend of the up-to-date remediation technology for soil contamination.

Key words: soil contamination, groundwater contamination, management method

－Priority Research Project－

Research on comprehensive hydrologic model for river basins

Research Period: FY2001-2005
Project Leader: Director of Hydraulic Engineering Research Group
NAGAYAMA Isao
Research Group: Water Environment Research Group
Hydraulic Engineering Research Group

Abstract:
Water environment in river basins has been deteriorated by human activities such as various way of water use and changes in land use. In order to solve the diverse problems related to the river basins, it is essential to establish the integrated water management that balances flood mitigation, water use and ecosystem and to restore sound hydrologic cycle system. This research project aims to clear significant hydrologic processes in the river basin and to develop comprehensive hydrologic models of river basins which are necessary to evaluate the effects of various restoration efforts.

Key words: river basin, flood mitigation, water use, ecosystem, hydrologic cycle system, comprehensive hydrologic model of river basin

－Individual Themes－

A study on generalized hydrological models and its modeling system

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: Hydrologic Engineering
Author: FUKAMI Kazuhiko
KINOUCHI Tsuyoshi
KURIBAYASHI Daisuke

Abstract:
The goal of this study is to provide a guideline for appropriate application of hydrological models and its combinations. The results for this year are as follows: most common models were tested by applying initial estimate of parameters in eighteen watershed and compared each other, stability of the model parameters were examined by using Jackknife method, the models were applied to urban runoff before and after drastic land use change, and the check list for the guideline has been improved.

Key words: hydrological model, simulation, guideline, check list

water and material cycle in urbanizing river catchments

Budged: Grants for operating expenses
River account
Research Period: FY1999-2004
Research Team: Hydrologic Engineering
Author: FUKAMI Kazuhiko
KINOUCHI Tsuyoshi
IIZUMI Yoshiko

Abstract:
The purpose of this research is to understand the condition of water and material cycle and develop a simulation model for basin-scale water and material cycle.

In 2004, we clarified ground water flow with dissolved material at experimental field in the Yata River basin. Then, the program to estimate the input and out put of nitrogen was established, together with a model to estimate the concentration of nitrate nitrogen of groundwater and river water. Also, WEP model was applied to the Takasaki River basin in Chiba Prefecture to simulate the change of water cycle caused by urbanization.

Key words: urbanizing river catchments, water cycle, material cycle, model, nitrogen

Research on the development of low flow management support system

Budged: Grants for operating expenses
General account
Research Period: FY2000-2005
Research Team: Hydrologic Engineering
Author: FUKAMI Kazuhiko
INOMATA Hironori

Abstract:
The purpose of this research is to develop the methods to analyze how much the change of water usage at farmlands or the change of forest gives the impact on the river flow condition, and to develop a low flow management support system.

In this fiscal year, we applied WEP model to Yasu River Basin to figure out the feature of water circulation in Yasu River Basin and verified.

Key words: low flow management, water balance at farmlands, effect of forest, WEP model

A study on influence of catchment area and river form on river ecosystem

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: River Restoration
Author: AMANO Kunihiko
DENDA Masatoshi
TOKIOKA Toshikazu

Abstract:
We studied the relationships between land use in a catchment and a river ecosystem. Contents and stable isotope ratios were determined for nitrate, suspended solids, periphyton, and Stenopsyche marmorata larvae. We estimated contribution of sewage waste to suspended solids and S. marmorata larvae, using carbon and nitrogen stable isotopes analysis. This study shows that the area ratios of urban land and farmland affected POM through nitrate input, and thus S. marmorata larval biomass.

Key words: land use, GIS, stable isotope ratio, river ecosystem

－Priority Research Project－

Study on the restoration of natural environment in rivers and lakes

Research Period: FY2001-2005
Project Leader: Reader of River Restoration Research Team
AMANO Kunihiko
Research Group: Water Environment Research Group

Abstract:
Natural environment in rivers and lakes is important for various wildlife as their habitat. Rivers and lakes in good environmental condition can also provide recreational place for people. Therefore, it is demanded to develop techniques to restore natural environment in rivers and lakes. These techniques can not only avoid or reduce negative impacts of river works and management, but also provide and maintain good habitat for aquatic lives.

Several typical human disturbances on rivers and responses of ecosystems to them, the formation of good habitats using river flow, restoration of lake littoral vegetation zone, development of new survey method using information technology, and restoration of continuity of streams are investigated in this study.

Key words: restoration, aquatic ecosystem, anthropogenic disturbance, lake littoral zone, telemetory, ecological network

－Individual Themes－

Study on anthropogenic impacts and ecological responses in rivers

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: River Restoration
Author: AMANO Kunihiko
KAYABA Yuichi
MURAOKA Keiko
OISHI Tetsuya

Abstract:
Last several decades, human impacts like river works have deteriorated river ecosystem. In order to realize a sustainable ecological system in rivers, a new approach to predict responses influenced by the impacts has to be developed. In this research, several types of the impacts are taken, and the process between the impacts and response will be cleared. In 2004 fiscal year, we analyzed the importance of the structure of stream margin, focusing on the streamside plants, overhang, and shallow water area. Results showed that overhanging cover provide habitats suitable for fishes. Shallow water area where flow velocity is low seemed good habitat for juvenile fishes.

Key words: anthropogenic impact, ecological response, river, straightening, channel incision

A fundamental survey on environmental flow involving natural regime

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: River Restoration
Author: AMANO Kunihiko
KAYABA Yuichi
MINAGAWA Tomoko
TASHIRO Takashi

Abstract:
This research has aimed to clarify the influence that the flow fluctuation gives to the living thing in the river and the water quality and the sediment supply gives to the habitat and the living thing quantitatively, and to contribute to the river management of environmental flow in the future. The result in 2004 is as follows:
1) TOC balance in experimental streams was estimated based on the growth of attached algae in normal flow and the disloadgement of deposited POM and attached algae in flood event, applying diural curve method to calculate primary production and respiration of an aquatic community. As a consequence, it was shown that outflowing TOC from the experimental streams for 3 hours in the flood was equivalent to the quantity accumulated for 20 days in base flow.
2) To make clear of evaluation of periphyton for food of Plecoglossus altivelis, periphyton were collected from the cobble and boulders with and without grazing scars of Plecoglossus altivelis. According to the results, AFDM(%) and the ratio of living algae biomass to living algae and died algae biomass in periphyton used for food were higher than periphyton not used, and AFDM(%) of periphyton used for food is higher than 40%.
3) In a gravel river with decreased disturbances, the substratum adhesion was investigated by using simple equipment made from a drag rake and a spring scale. According to the results, the strength of substratum adhesion which was caused by the inhabitation of benthic invertebrates was clarified to reach about three times as large as that without the invertebrates. Consequently, the substratum adhesion could be quantitatively recognized as the serious issue in the controlling flow and disturbance regime for river ecology.

Key words: natural flow regime, periphyton, benthos, self-pollution, flood.

Environmental function of lakeshore vegetation

Budged: Grants for operating expenses
River account
Research Period: FY2000-2004
Research Team: River Restoration
Author: AMANO Kunihiko
NAKAMURA Keigo
OISHI Tetsuya

Abstract:
We evaluated the constructed lakeshore restoration sites in Lake Kasumigaura. Twenty-one restored lakeshores were compared based on diachronic aerial photos, construction documents and field surveys. Our results illustrate that 1) the lakeshore restoration basically fulfils its object, i.e., it has mostly succeeded to conserve or expand the vegetation area, 2) enclosed ratio, the degree of enclosure around the lakeshore by breakwaters, jetties, and lakeshore, is proportional to the rate of vegetation expansion; however, high enclosed ratio might deteriorate the sediment quality, 3) lakeshore sinuosity, the complexity of lakeshore line, has gradually increased even if initial lakeshore is a straight line, 4) wave disturbance plays a crucial role to maintain the physical habitat diversity composed of both lakeshore beach and vegetation.

Key words: Lake Kasumigaura, lakeshore, restoration, lake littoral zone, nature-oriented river works

Development of new wildlife location system using information technology

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: River Restoration
Author: AMANO Kunihiko
DENDA Masatoshi

Abstract:
An automatic fish positioning system with transmitter was developed. The system, ATS (Advanced Telemetry system), can locate a transmitter in water with an average error of 11.86m. We carried out an experiment and succeeded in tracking fish behavior every 210 seconds during twelve days. The fish behavior data was analyzed and it showed that home range of the fish was 1,000 ㎡ in average, and the fish moved actively after sunrise and after sunset. This suggests that ATS is a useful tool for researching fish behavior and its preference.

Key words: Telemetry, automatic fish positioning system, ethological pattern, home range

Aquatic life influenced by division of stream network around river, and its restoration

Budged: Grants for operating expenses
General account
Research Period: FY2002-2005
Research Team: River Restoration
Author: AMANO Kunihiko
MURAOKA Keiko

Abstract:
The paddy field area is important for the habitat of fishes, and for a spawning ground of several sorts of fish who lives in rivers. In recent years, streams connecting rivers and paddy field area have been divided by modification of irrigation system. In this research, the genetic structure of Medaka population in Lake Kasumigaura was analyzed and human introduction of different type was detected. Also conducted is fish sampling survey in Arakawa river. Fish number and species were examined at the node of two branch streams to consider the influence by the difference of the stream types around Arakawa and the restoration of the water-network around river and paddy field area was considered.

Key words: fishes habitation environment, temporary water area, paddy field, mitochondria

－Priority Research Project－

A study on water quality/sediment control technologies for reservoirs and rivers downstream

Research Period: FY2002-2005
Project Leader: Reader of Dam Hydraulic Engineering Research Team
KASHIWAI Josuke
Research Group: Hydraulic Engineering Research Group

Abstract:
The goal of this study is to establish the water quality/sediment control technologies of reservoirs for sustainable use of reservoirs and environmental conservation of rivers downstream. With regard to the sediment control technologies of reservoirs, estimation methods of abrasion using hydraulic model tests for sediment transport facilities were investigated. Erosion process of mounded sediment removed from reservoirs by excavating and dredging were analyzed through hydraulic experiments. With regard to the river restoration technologies, initial erosion condition and process of fine deposited sediment was examined using sedimentation materials of a reservoir. Also, basic idea of test facility for algae separation was indicated and required algae's recovering duration from separation was summarized.

Key words: water quality, sediment control, reservoirs

－Individual Themes－

Abrasion of sediment transport channel by sand and gravel

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: Dam Hydraulic Engineering

Author: KASHIWAI Josuke
MIYAWAKI Chiharu
INOUE Kiyotaka

Abstract:
In order to supply sediment to dams downstream or prevent capacity loss of dam reservoirs, facilities, which transport inflow sediment to downstream rivers, should be developed. That requires establishment of countermeasure technology against abrasion. Goals of the investigation are developing estimation methods of abrasion and understanding abrasion characteristics of lining materials. Concerning the estimation methods of abrasion, hydraulic model test will be employed. In fiscal 2004, foaming polymer phenol material was chosen as the wall material of model tests and the relationship between abrasion and collision energy of sands was developed by the tests where collision angle was varied. Law of estimating the quantity of prototype abrasion from model tests was examined by the observation and comparison analysis of sediment motion on the wood and foaming polymer phenol floor. Also, the abrasion test facility designed in fiscal 2003 was produced.

Key words: sediment management, sedimentation, sediment transport facility, abrasion damage, collision energy

Behavior of supplied sediment from dam

Budged: Grants for operating expenses
River account
Research Period: FY2003-2005
Research Team: Dam Hydraulic Engineering

Author: KASHIWAI Josuke
SAKURAI Toshiyuki
INOUE Kiyotaka

Abstract:
From the viewpoints of sustainable use of dam reservoirs and river restoration, sediment supply to a river downstream from a dam reservoir is required. Sedimentation countermeasures, such as sediment bypassing, flushing, and resettling in river area, have been increasingly employed. In order to supply sediment to a river downstream, it is necessary to estimate and evaluate sediment performances in a river. The examinations, however, have been promoted for each project, and systematization of the methods is required. The goal of this investigation is to elucidate supplied sediment performances mainly concerning the flushing process of resettled sediment during flood. In 2003 fiscal year, general phenomena of the erosion of settled mound on a fixed bed was examined by experiments in over water condition of mound upper surface. The erosion phenomena could be separately discussed as the flow into part of upstream face and parallel flow part of side face of middle and downstream part. In 2004 fiscal year, erosions of long side face mound were tested and the sediment flow rate of both part were analyzed. The calculation method of the erosion process of side face was also examined.

Key words: sediment management, sedimentation, sediment resettlement, erosion, sediment flow rate

Relationship between discharge variation of dam downstream and river restoration

Budged: Grants for operating expenses
River account
Research Period: FY2004-2005
Research Team: Dam Hydraulic Engineering

Author: KASHIWAI Josuke
YUKI Kazuhiro
OGURO Maki

Abstract:
Since the discharge variation is reduced by the control function of a dam reservoir, river environment is influenced by the reduction of discharge fluctuation. That may damage the normal growth of attached algae, which is important feed of fishes, and change riverbed situation for benthos by the accumulation of fine sediment. Fine sediment accumulation may also reduce the spawning places. Goals of the investigation are to find the examination methods for deciding the required frequency, discharge rate and duration of flushing operation, and propose reservoir management methods for flushing operation. In 2004 fiscal year, erosion condition of deposited fine sediment was examined through hydraulic experiment, basic idea of test facility for algae separation was indicated and required algae's recovering duration from flushing was summarized.

Key words: dam reservoir, river environment, discharge fluctuation

－Priority Research Project－

Research on techniques for treating bottom sediment at enclosed water areas

Research Period: FY2002-2005
Project Leader: Director of Water Environment Research Group
SAGO Junzo
Research Group: Water Environment Research Group
Material and Geotechnical Engineering Research Group

Abstract:
Contaminated sediment in a eutrophic lake causes elution of nitrogen and phosphorus, and is one of the major causes of water pollution. In Japan dredging is a main countermeasure against contaminated sediment. However, due to new problems such as endocrine disrupters, toxic substances, and conservation of biodiversity, the development of new sediment treatment methods is required. In this project we study a sediment treatment method that causes less damage to the benthic ecosystem, risk management and stabilization of bottom sediment, standardization of the method for evaluating sediment treatment techniques, and countermeasures for inflow sediment from rivers.

Key words: lake sediment, nutrient salts, polycyclic aromatic hydrocarbons, benthic ecosystem, artificial lagoon

Transport of contaminants through sediment-water interface

Budged: Grants for operating expenses
River account
Research Period: FY2000-2005
Research Team: Water Quality
Author: SUZUKI Yutaka
TSUMORI Jun

Abstract:
The aim of this study is to clarify release mechanisms of nutrients form lake and reservoir sediments from the viewpoint of eutrophication countermeasure.

In FY 2004, we conducted experiments of oxygen supply to bottom layer in a reservoir to evaluate the effect of oxygen concentration on phosphorus release, and potentials of nutrients release from the sediments of the reservoir were evaluated with laboratory experiments using collected sediment samples. The following results were obtained.

1) In the oxygen supply experiment in the reservoir, temperature, DO and ORP in water column were continuously monitored with sensors, and we observed continuous change of oxidation-reduction potential and nutrients concentrations in water column with or without oxygen supply. From the monitoring, relationship between the oxygen conditions and phosphorus concentrations was observed, the phosphorus concentrations showing increase during anaerobic conditions and decrease during aerobic conditions. In addition, the effectiveness of ORP as an indicator of phosphorus release was suggested.

2) Nutrient release tests using sediment core samples under anoxic condition were carried out for sediments collected before and after oxygen supply experiments in the reservoir. The result was that the potentials of PO4-P and NH4-N release were decreased after the oxygen supply to the bottom layer.

3) Batch stirring experiments were conducted using sediment samples, and the rates and potentials of nutrient release from sediments under aerobic and anoxic conditions were quantitatively assessed. From the experiments, following results were obtained; phosphorus release rate was significantly high at the early stage of the experiment under anaerobic condition, however, the rapid release was ceased after 2days; the phosphorus rapidly released was considered to have been combined with metal ions such as Fe; phosphorus release rate under aerobic condition was slow, but the final amount of phosphorus release reached 25 – 50% of that under anaerobic condition.

Key words: sediment, nutrients, elution, DO, ORP, monitoring.

Status of pollution and fate of polycyclic aromatic hydrocarbons in lake sediment

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: Recycling
Author: OZAKI Masaaki
YAMASHITA Hiromasa

Abstract:
Environmental pollution caused by hazardous organic substances has become a problem: the hazardous organic compounds that exist in watersheds concentrate in closed water bodies via rivers. In particular, several papers have reported on the pollution of bottom sediment of closed water bodies with polycyclic aromatic hydrocarbons (PAHs). We are investigating to clarify the status of pollution and fate of sediment with PAHs. In FY2004, it was revealed that the concentrations of PAHs in the sediment under the bridge with heavy traffic were high because of road runoff. According to a mass balance calculation of benzo[a]pyrene in a lake, it was also revealed that the main sources of benzo[a]pyrene were rivers and that the amount of benzo[a]pyrene removed by sediment dredging was larger than that accumulated in the sediment.

Key words: polycyclic aromatic hydrocarbons (PAHs), lake sediment, occurrence

Research on the new bottom sediment quality improvement techniques suitable for lake bottom ecosystem

Budged: Grants for operating expenses
River account
Research Period: FY2003-2005
Research Team: River Restoration
Author: AMANO Kunihiko
MURAOKA Keiko
TOKIOKA Toshikazu

Abstract:
We have investigated buried seeds of submerged plants that were important element of lake bottom ecosystem in lake Kasumigaura. To know the distribution of these seeds, we selected sampling points from which sediment cores were sampled. Sampling points were decided considering lake currents and areas of submerged plant colony in the past. Sediment cores are divided vertically and analyzed in terms of age of sedimentation and number of seeds in them.

Buried seeds were found even from a part of bottom sediments that was formed 90 years ago. However, the number of seeds that were germinated during germination experiment was highest in surface layer of bottom sediments. This implied that buried seeds will lose germination capability as time passes. Most buried seeds were found from bottom sediments located in enclosed areas. This showed that buried seeds can be found from bottom sediments beneath stagnant water area.

Key words: bottom sediments, submerged plant, Kasumigaura, buried seeds, age determination

Development of the artificial lagoon to control diffusive pollutants

Budged: Grants for operating expenses
General account
Research Period: FY2002-2005
Research Team: River Restoration
Author: AMANO Kunihiko
MURAOKA Keiko
OISHI Tetsuya

Abstract:
The term, “Artificial lagoon (AL)” is defined as an artificially constructed small lake or pond at a river mouth in a lake. The AL aims to control non-point source pollutants. The first AL was installed in 1998 at the river mouth of the Kawajiri River flowing into Lake Kasumigaura in Japan. The AL has an area of ~30,000 m2 and a depth of 1.0 m. We have been studying the performance of the AL, however the denitrification (DN) rate in the AL was not examined yet. Then, the DN was measured by the on-site gas trap method. The DN was occurred mainly at the vicinity of the river mouth where dissolved oxygen declines and nitrate flows in. The DN produces nitrogen gas at the rate of 400-500 mg/m2/day in summer. The average rate was 224 mg/m2/day around the river mouth between May and October, and 70 mg/m2/day at the other area. The annual DN was estimated at 520 kg/year in the AL and the DN removes 6.6 % of the annual nitrogen load.

Key words: Artificial lagoon, non-point source, water treatment technique, lake, inflow load

－Priority Research Project－

Research on improving the durability of structure and evaluating their performance

Research Period: FY2002-2005
Project Leader: Director of Road Technology Research Group
HAGIWARA Roji
Research Group: Construction Technology Research Department
Earthquake Disaster Prevention Research Group
Road Technology Research Group
Structures Research Group

Abstract:
Infrastructure should be more efficiently constructed to cope with the decreasing funds available for new infrastructures because of the falling birthrate and increase in maintenance of infrastructures. In the research project, technologies are being developed to upgrade the durability of infrastructures to reduce the life-cycle costs. Evaluation methods of the performances of structures and quality control techniques are also being developed to promote creative technological innovation by facilitating the development and application of new technologies and materials while adopting performance based standards.

Key words: infrastructure, durability, life-cycle cost, performance evaluation, quality control

－Individual Themes－

Research on life extension for pavement

Budged: Grants for operating expenses
Road account
Research Period: FY1998-2005
Research Team: Pavement
Author: ITO Masahide
SAKAMOTO Yasufumi
YABU Masayuki
TANIGUCHI Satoshi

Abstract:
To supply safe and comfortable pavement, development of the pavement which has advanced durability and an addition function, and a rational design are required. The aims of this study are to provide evaluation methods of pavement durability and performance, and to provide pavement design which is advanced durability against fatigue and performance of road surface.

In fiscal year 2004, this study mentioned about management target and computation of life cycle cost (LCC) for architecture of the pavement management system by performance evaluation, and method of evaluation for durability against fatigue.

The following things became clear as a result of this research.

1) Concept of pavement management target and matters which will be performed for establishing computation method of LCC.

2) Method of calculating average temperature of asphalt course for estimating number of wheel passes causing fatigue by deflection measured by FWD more exactly.

Key words: pavement management, management target, life cycle cost, number of wheel passes causing fatigue failure, FWD

A study on the rational design method of tunnel lining

Budged: Grants for operating expenses
Road account
Research Period: FY2000-2004
Research Team: Tunnel
Author: MASHIMO Hideto
ISAGO Nobuharu
ENDO Takuo

Abstract:
In the first part of this study, laboratory experiments and field measurements were carried out to clarify the effect of fiber reinforcements to prevent the occurrence of dry shrinkage crack. In the second, full-scale model tests simulating tunnel concrete lining were carried out to clarify collapse mechanism under a few kinds of load condition and reinforcing material. Finally, in order to establish the numerical analysis method that will be able to estimate the load-carrying capacity of tunnel lining and effect of fiber reinforcements, numerical analysis using FEM considering the development of cracks were carried out and the results were compared with experimental results.

Key words: tunnel lining, shrinkage, field measurement, loading experiment, steel fiber reinforced concrete, FEM analysis

A study on practical design method of pile foundations in liquefied foundation soil considering ground deformation

Budged: Grants for operating expenses
Road account
Research Period: FY2000-2004
Research Team: Ground Vibration
Author: SUGITA Hideki
TAKAHASHI Akihiro
TANIMOTO Shunsuke
MIKAMI Taku

Abstract:
In order to establish a design method of pile foundations in liquefied soils, applicable combination of inertia force of superstructures and deformation of ground is investigated through a series of centrifuge tests. The validity of seismic deformation method on bridge foundation in liquefiable soils was investigated through a series of numerical analysis.

Key words: liquefaction, bridge foundation, deformation of ground, seismic deformation method

A study on numerical modeling of deep foundations for the seismic performance assessment of highway bridges

Budged: Grants for operating expenses
Road account
Research Period: FY2001-2004
Research Team: Foundation Engineering
Author: FUKUI Jiro
SHIRATO Masahiro
NONOMURA Yoshinori

Abstract:
We proposed a new load transfer nonlinear hysteretic mechanism for Winkler type soil-pile interaction springs having experimental and geotechnical backgrounds, based on the past studies in this research project. Numerical check using the proposed model coincided well with the experimental results of single piles subjected to reversed or one-sided horizontal cyclic loads and reproduced the difference in the behavior of the piles depending on the loading patterns. In addition, we extended the proposed model in order to
consider the pile-group effects.

Key words : dynamic analysis, foundation, seismic design, winkler

A study on development of evaluation methodology for bridge aerodynamic stability

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Bridge Structure
Author: MURAKOSHI Jun
FUMOTO Koichiro
INAGAKI Yukiko

Abstract:
Aerodynamic stability of highway bridge is usually investigated by wind tunnel tests, which often spend long time and much cost. The research aims at development of evaluation methods for aerodynamic stability of bridge girders without wind tunnel tests.

In FY2004, focusing on simplified twin-girder bridges, simple prediction formulae of critical wind speed for flutter and galloping, and of critical wind speed and amplitude of vortex-induced vibrations were proposed based on the results of wind tunnel tests and field vibration measurements last FY. And mode analyses for a twin-girder bridges with rubber bearing were conducted in order to evaluate the effect of stiffness of rubber bearing to the natural frequencies.

Key words: twin- girder, aerodynamic stability, wind tunnel test, vibration experiment

International cooperative research for seismic performance evaluation methods of structures (1)

Budged: Grants for operating expenses
General account
Research Period: FY2000-2004
Research Team: Earthquake Engineering
Author: UNJOH Shigeki
NISHIDA Hideaki
SHIOJIMA Akihiko

Abstract:
The objective of this study is to propose the standardized seismic performance evaluation method of the bridge on the basis of cyclic loading test and shaking table test in collaboration with Federal Highway Administration (FHWA). Main results of this study are as follows; 1) In case of using scaled model, adjustment of scale factor is important especially the ductility characteristic evaluation, 2) Cyclic loading patterns are proposed based on nonlinear time historical analysis results of the RC column and 3) The guideline for seismic performance testing of bridge piers is proposed.

Key words: seismic performance evaluation, experimental test methods, bridge pier, cyclic loading test, shaking table test

International cooperative research for seismic performance evaluation methods of structures (2)

Budged: Grants for operating expenses
General account
Research Period: FY2000-2004
Research Team: Foundation Engineering
Author: FUKUI Jiro
SHIRATO Masahiro
NONOMURA Yoshinori

Abstract:
This study developed a new system to estimate the characteristic value of compressive bearing capacity of a pile. The new system is comprised of two methods based on in-situ pile load test results and past pile load test database. Both methods can account for the reliability of the number of pile load test data and the applicability of ground investigation method, and harmonize the recent international trend in design code.

Key words: pile, bearing capacity, reliability design, geotechnical parameter, characteristic value

A study on countermeasure methods to reduce traffic-induced vibration on bridges

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Bridge Structure
Author: MURAKOSHI Jun
FUMOTO Koichiro
NAGAYA Yuko

Abstract:
The effective countermeasures to reduce traffic-induced vibration on bridges and surrounding areas are required to ensure good environmental condition and to improve the durability of bridges. This research aims to clarify the dynamic responses of bridges of subjected to truck-traffic running, to propose their estimation methods of bridge dynamic responses and to develop effective countermeasures to reduce traffic-induced vibration.

In F.Y.2004, construction method of extended deck system which is developed as a countermeasure to reduce traffic-induced vibration at expansion-joint was discussed. Benchmark study was conducted in order to compare analytical results by PWRI analytical tool with other analytical tools.

Key words: traffic-induced vibration, countermeasure to reduce vibration, vibrating analysis, extended deck system, design, construction

A study on the performance specification of subgrade in consideration of the durability of pavement (1)

Budged: Grants for operating expenses
Road account
Research Period: FY2001-2004
Research Team: Pavement
Author: ITO Masahide
SAKAMOTO Yasufumi

Abstract:
Performance specification is advanced in order to aim at development promotion of new technology, and curtailment of construction cost. Although performance specification is already attained about pavement structure, it is surmised that performance specification will be needed also about subgrade and filled up ground supporting pavement. Since a subgrade is what supports traffic load united with pavement, where pavement is built, it needs to examine the performance. In order to examine pavement structure, the theoretical analysis which made the index physical constants, such as not the index based on the characteristic and the construction state of material like CBR or the degree of compaction but an elastic coefficient of each material, is needed. Then, in this research, it inquired by the actual proof techniques, such as theoretical analysis and an experiment. Consequently, it turns out that compressive strain produced on the upper surface of subgrade is effective. And the method of the performance regulation which can secure the durability of pavement was able to be proposed by the compressive strain. Moreover, it was able to be shown that it is useful to this proposal reducing construction cost.

Key words: subgrade, filled up ground, performance specification, compressive stress, compressive strain

A study on the performance specification of subgrade in consideration of the durability of pavement (2)

Budged: Grants for operating expenses
Road account
Research Period: FY2001-2004
Research Team: Construction Technology
Author: OSHITA Hiroshi
HADA Mitsutaka
NAKASHIMA Shinichiro

Abstract:
For performance specification of road subgrade, it is needed to develop in situ test methods that can evaluate deformation modulus of subgrade easily and with high accuracy. Handy Falling Weight Deflection meter (HFWD) and Rapid Plate Loading test meter (RPL) are portable testing machines that measure deformation characteristics of the ground surface. In order to grasp their accuracy of measurement, the time for measurement and the range of application, laboratory and field experiments were conducted. From the results, it is confirmed that HFWD and RPL can evaluate deformation modulus with almost the same accuracy as Static Plate Loading test (SPL), which is the most popular but an uneasy-to-use method. Therefore, HFWD and RPL can be used for quality check and evaluation during subgrade construction, and the value can be used for the pavement design through calculation such as elastic analyses.

Key words: subgrade, deformation modulus, plate loading test

－Priority Research Project－

Research on evaluating the soundness of infrastructure stock and its remedial techniques

Research Period: FY2001-2005
Project Leader: Director of Construction Technology Research Department
MIKI Hiroshi
Research Group: Construction Technology Research Department
Material and Geotechnical Engineering Research Group
Road Technology Research Group
Structures Research Group

Abstract:
Studies on evaluation method for soundness and safety of existing bridge foundations, method to check the soundness of ground anchors and their repairing or reinforcing method, repair techniques for low noise and low vibration function of pavement, repair and reinforcement method for damaged existing tunnels, evaluation of structural soundness of bridges and development of bridge management system, advanced technology in steel bridge repainting were conducted.

Key words: monitoring, inspection, deterioration and damage, maintenance, bridge, bridge substructures, ground anchors, concrete structures, bridge management system, steel bridge repainting, pavement management system

－Individual Themes－

Research on evaluation method of soundness of bridge substructures

Budged: Grants for operating expenses
General account
Research Period: FY2001-2004
Research Team: Foundation Engineering
Author: FUKUI Jiro
ISHIDA Masahiro
NONOMURA Yoshinori

Abstract:
There are about 140,000 highway bridges in Japan, and rational management is very important in the limited budget. Many bridge substructures are damaged because of scour of river bed around foundations. It is necessary to establish an evaluation method for soundness and safety of existent bridges.

In this research, the factor was analyzed based on the failed bridge cases by scour. Next, the estimation method to evaluate capacity of foundations on scour, and scour estimation equations were examined about the result of scour inspection. It proposed the soundness evaluation technique based on these results. It came to be able to extract the damaged bridges by scour by this technique more clearly.

Key words: foundation, scour, soundness, damage, inspection

Study on soundness check and reinforcement of existing ground anchor

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: Construction Technology
Author: OSHITA Hiroshi
ONODERA Seiichi
ITANI Masashi

Abstract:
The ground anchor has been applied in lots of sites since the first introduction in Japan more than 40 years ago. Among those that were constructed at an early stage, there are some anchors whose construction and anti-corrosion technology were immature. Problems such as breaking and protruding of anchor tendon due to the corrosion have come to be seen lately. In order to prevent these problems, it is necessary to develop methods to check the soundness of existing anchors and to repair or reinforce the defective anchors.

In 2004, the soundness of actual anchors which were constructed about 20 years ago was investigated to see the actual situation as well as potential problems of old anchors, to look into the applicability of some soundness check measures. Basic test on corroded prestressing tendon was carried out to examine the applicability of Ultrasonic Detection method as soundness check of anchor tendon.

Key words: ground anchor, soundness check, ultrasonic detection method, corrosion, reinforcement

Study on recovery of the low noise and the low vibration function of pavement

Budged: Grants for operating expenses
Road account
Research Period: FY2000-2004
Research Team: Pavement
Author: ITO Masahide
KONAGAI Akihiro

Abstract:
The purposes of this study are to propose the method of recovery of the noise reduction function of pavement and to develop the low vibration pavement.

The research results were as shown;

1) It was proposed the method, in consideration of cost, of recovery of the noise reduction function of pavement by clean machines.

2) Three types of low vibration pavement were developed.

Key words: drainage pavement, recovery of function, permeability, vibration level, measure of vibration

Development of rational repair and reinforcement of damaged existing tunnel

Budged: Grants for operating expenses
General account
Road account
Research Period: FY2000-2004
Research Team: Tunnel
Author: MASHIMO Hideto
ISHIMURA Toshiaki
HAKOISHI Yasuhiko

Abstract:
In this study, to propose the design method of rational repair and reinforcement of existing tunnel lining, the followings investigation was carried out. In the first part of this study, the loadbearing capacity and the mechanism of failure of the concrete lining with repairs or reinforcements were clarified by the full-scale model test or partial model tests. The estimation method of loadbearing capacity of them was also proposed based on the model test results. Secondly, new repairs and reinforcements using new material were developed. Finally, the numerical simulation for the damaged concrete lining was carried out to evaluate the load which caused the damage.

Key words: tunnel, damaged concrete lining, prevention of concrete spalling, inner concrete lining, carbon fiber sheets

Survey of the improvement of steel bridge repainting technologies

Budged: Grants for operating expenses
General account
Road account
Research Period: FY2001-2005
Research Team: Advanced Technology
Author: YAMAMOTO Hiroshi
ISHIMATSU Yutaka

Abstract:
Steel bridges are social capital whose durability is assured by painting etc., and in order to maintain the good condition of paint membranes that protect the steel structure from corrosion, it is necessary to appropriately repaint them after a certain stipulated period. The durability of a paint membrane is determined by the corrosion resistance of the paint and quality of the surface. Surface preparation is said to have a great impact on the repainting of an existing steel bridge, and the theme was research on surface preparation technologies for steel bridge repainting.

In FY2004, specimens that simulate adhering salt that is, among the qualities of surface preparation that impact the durability of a paint membrane, difficult to deal with by a visual external examination, were prepared with the same quantity of adhering salt as present steel bridges by multiple cycle testing (JIS Z5621). When a steel bridge is repainted, parts where the paint membrane has deteriorated causing rusting are blasted and cleaned, but the residual salt was measured with the blast material, cleaning temperature, and cleaning ejection pressure as parameters to confirm their effects. In order to clarify the impact on paint membrane durability of paint surface preparation, specimens with varying types of salt concentrations were prepared to investigate the durability of the paint membrane to estimate the allowed adhering salt.

Key words: steel bridge, painting, surface preparation, adhering salt

A study on upgrade of steel bridge repainting

Budged: Grants for operating expenses
Road account
Research Period: FY2003-2005
Research Team: Advanced Materials
Author: NISHIZAKI Itaru
MORIYA Susumu

Abstract:
The repainting is indispensable for the steel bridge. However, the extension at repainting intervals is requested by using excellent paints in durability to reduce the maintenance cost painting. Therefore, the performance evaluation and durability of new paints which can reduce the painting expense are evaluated.

Key words: steel bridge painting, painting cost, performance, durability, spray coating

Research on evaluation of structural soundness and development of bridge management system

Budged: Grants for operating expenses
General account
Research Period: FY2001-2004
Research Team: Bridge Structure
Author: MURAKOSHI Jun
FUMOTO Koichiro

Abstract:
It is necessary to establish an effective system for bridge maintenance and replacement in order to maintain a large amount of bridge stocks efficiently under limited budgets and to prolong their lifespan. The aim of this research is to develop prototype of Bridge Management System (BMS) which supports decision making of project plan for maintenance, repair and replacement of bridges.

In FY2004, program of BMS prototype which consists of 5 modules was developed. Using this prototype, case studies were conducted using actual bridge inspection data administrated by a local branch office of MLIT in order to evaluate the total life cycle costs for several repair scenarios.

Key words: highway bridge, maintenance, management system, bridge integrity evaluation, deterioration prediction, bridge inspection

－Priority Research Project－

Research on improving infrastructure using new, untapper, and recycled materials

Research Period: FY2001-2005
Project Leader: Director of Material and Geotechnical Engineering Research Group
KAWANO Hirotaka
Research Group: Construction Technology Research Department
Material and Geotechnical Engineering Research Group
Road Technology Research Group
Structures Research Group

Abstract:
Public requirements for future infrastructure are high-performance, low-cost structures by using advanced materials and construction methods, and a recycling type of construction system with uses waste materials. This research project therefore focuses on developing high-strength steel re-bar, fiber reinforced plastic for civil engineering structures and improving material recycling technology by using non-standard aggregates, organic wastes, and other industrial wastes.

Key words: high-performance structures, low-cost structures, advanced materials

－Individual Themes－

Design method of RC members using high strength rebar as shear reinforcement

Budged: Grants for operating expenses
Road account
Research Period: FY2001-2004
Research Team: Structure Management Technology

Author: KAWANO Hirotaka
WATANABE Hiroshi
MORIHAMA Kazumasa
NAKAMURA Eisuke

Abstract:
It is essential to prevent shear failure to ensure enough seismic performance of RC structures. Amount of shear reinforcement should be increased to obtain enough shear strength of some RC structures, which can cause difficulty to construct them because of congestion of arrangement of rebars. High strength rebar is one of alternatives to solve congestion of shear reinforcement, whereas design method for RC members using high strength rebar as shear reinforcement, has not yet been developed.

We carried out cyclic reversal loading test of RC members using high strength shear reinforcements whose yield point were approximately 800MPa and 1400MPa. Also, material test of bending corner of high strength rebars was implemented. Results of the experimental study are as follows:

1) According to JSCE standard specification for structural concrete, tensile strength of shear reinforcement up to 800MPa are allowed if characteristic strength of concrete is more than 60MPa. However, the experimental results show that high strength shear reinforcement fully functions even normal strength concrete is used.

2) High tensile strength of rebar can not be utilized if concrete is seriously damaged by inelastic load reversals. If plasticity factor of applied displacement exceeds the value calculated by Japan Highway Bridge Specification, the specimens caused failure although the high strength shear reinforcement did not reach its yield point.

3) High strength rebars don't perform desirable properties required as shear reinforcement if the diameter of bending corner is relatively small. For instance, failure of bending corner and decrease of tensile strength are detected.

Key words: reinforced concrete, shear, high strength rebar, properties of bending corner

Study on the application of FRP to road infrastructures (1)

Budged: Grants for operating expenses
Road account
Research Period: FY2001-2005
Research Team: Advanced Materials
Author: NISHIZAKI Itaru
KISHIMA Takeshi

Abstract:
Road infrastructures in coast areas in Japan are exposed to severe corrosive environment with sea salt, and the cost for the countermeasure against corrosion is much increasing. One of the new techniques to establish anti-corrosive road infrastructures is to apply anti-corrosive materials. This study focused on the application of FRP (Fiber Reinforced Polymers) to road infrastructures as anti-corrosive structural materials.

In 2004 fiscal year, the researchers conducted the experiment on the Glass FRP (GFRP) bolted joints, because joint property of FRP is one of the key technology in this area and more information is required to construct real-sized structural members. The researchers obtained the results mainly on the joint properties, especially on the factors that affect to the joint strength. The types of bolted joints are both the friction-type bolted joint generally used in steel structures and the bonded-bolted joint with adhesive generally used in FRP structures.

Future works will focus on the design method of the secondary bonded I-shaped FRP beam and the usability and the cost-performance of FRP pedestrian bridge.

Key words: FRP friction-type bolted joint, bonded-bolted joint, bolt, adhesive

Development of effective use technology of recycled aggregate

Budged: Grants for operating expenses
General account
Research Period: FY2001-2005
Research Team: Structure Management Technology

Author: WATANABE Hiroshi
KATAHIRA Hiroshi

Abstract:
It is very important to ensure enough durability of recycled aggregate concrete for its common application to civil structures. Resistance against freezing-thawing effect is one of crucial performance for recycled aggregate concrete. We have developed a simplified test method to assess recycled aggregate performance against freezing-thawing action. It is shown that the developed test method can be used to assess performance of recycled aggregates and their applicability for civil concrete structures.

key words: recycled aggregate, freeze-thaw resistance, air content

Recycling of organic wastes in sewage treatment system

Budged: Income from entrusted research
(expectation)
Research Period: FY2002-2005
Research Team: Recycling
Author: OZAKI Masaaki
OCHI Shuichi
SHOJI Hitoshi

Abstract:
To develop the recycling process of organic waste, especially wood waste, combined with sewage treatment, the anaerobic fermentation with sewage sludge was examined. The lab-scale experiment indicated that wood waste could be the source of acetate production by fermentaion. Moreover, the liquid composting process was applied for sewage sludge. It was found that efficient composting was achieved when the temperature was appropriate. From the microbiological point of view, the population dynamics as well as the treatment ability was important to estimate and optimize the processes.

Key words: biomass, fermentation, wood waste, composting, bio-solid

Recycle technology of industrial waste materials

Budged: Grants for operating expenses
General account
Research Period: FY1999-2005
Research Team: Advanced Materials
Recycling
Soil Mechanics
Author: MEIARASHI Seishi
NISHIZAKI Itaru
TOMIYAMA Tomonori
OZAKI Masaaki
MIYAMOTO Ayako
KOHASHI Hidetoshi
MORI Hirotoshi

Abstract:
The purposes of research are establish the evaluation methodology of recycle products made from industrial waste materials and publish “Technical Guideline on Recycle Products of Industrial Waste Materials”.

In this financial annual year, we identified that all the waste glass aggregate caused alkali-silica reaction with motor-bar testing method. We also found that lower-alkali and portland blast-furnace slag cement content prevent the reaction. Hearing from researchers related to waste material recycling project gave us very precious information to complete “Technical Guideline on Recycle Product of Industrial Waste Materials”.

Key words: industrial waste material, recycle, construction industry, technical guideline, alkali-silica reaction, waste glass

Use of non-construction by-products to pavement

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2004
Research Team: Pavement
Author: ITO Masahide
KONAGAI Akihiro

Abstract:
The purpose of this study is to clarify the durability and the additional function of glass mixed asphalt pavement and block pavement, it examined at the laboratory and the pavement run test field.

The test results were as shown;

1) The pavement which changed 30% of aggregate for glass cullet could be constructed by improved asphalt and it could improve the visibility of road surfaces.

2) The cost of making glass mixed asphalt pavement was much cheaper than silicon carbide aggregate mixed pavement.

3) The block pavement which changed 100% of aggregate of the surface for glass cullet could be constructed and it could improve the visibility of the surfaces much better than that of the glass cullet mixed asphalt pavement.

Key words: non-construction by-products, glass cullet, asphalt pavement, block pavement, luminance

－Priority Research Project－

Research on efficient construction and redevelopment of dams considering surrounding environment

Research Period: FY2001-2005
Project Leader: Director of Hydraulic Engineering Research Group
NAGAYAMA Isao
Research Group: Construction Technology Research Department
Material and Geotechnical Engineering Research Group
Hydraulic Engineering Research Group

Abstract:
When new dam reservoirs are constructed to meet the need of flood control and water supply, the impact on the surrounding natural environment should be minimized. In this research project, design technology such as heightening the dams and installing new discharge facilities in the dams will be developed in order to utilize existing reservoirs more effectively. In the case of new dam construction, technology for the effective utilization on construction materials will be developed. Survey and design technology for dam foundations and reservoir slope will be studied in order to minimize the impact on the topography and environment of project areas.

Key Words: heightening dams, reconstruction of water discharge facilities, effective use of weak rock as construction materials, stability of dam foundation and reservoir slope, seepage control in dam foundation

－Individual Themes－

Investigation on redevelopment technique of concrete dams

Budged: Grants for operating expenses
River account
Research Period: FY2001-2004
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
SASAKI Takashi
KANENAWA Kenichi
ISHIBASHI Masayoshi

Abstract:
Considering preservation of environment and cost reduction in the public works, it is necessary to utilize existing dams and reservoirs more effectively. On the study of heightening existing dams, we developed rational design methods for heightening dams. On the study of installing new discharge facilities to existing dams, we developed rational design methods for installing new discharge facilities to existing dams.

Key words: concrete gravity dam, heightening dams, installing new discharge, stability of dam body during large earthquake

Investigation on heightening techniques for embankment dams

Budged: Grants for operating expenses
River account
Research Period: FY2001-2004
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
TOMIDA Naoki
SATO Hiroyuki
KOBORI Toshihide

Abstract:
Efficient use of existing dams is strongly required for natural environment conservation and cost reduction in dam construction. Objective of this study is to propose the investigation, design and monitoring methods for heightened embankment dams.

In this study, we confirmed that physical properties and/or location of concentrated leakage in existing embankment dams can be detected by electrical detection to some degree. We proposed the design method for heightening embankment dams and revealed the concrete remarks on the design. In addition, we suggested the way to measure the deformation of submerged existing dam body and/or the boundary between existing and new dam bodies was developed, and confirmed the device can monitor the displacement distribution of dam slope surface well.

Key words: embankment dams, heightening, hydraulic fracturing, newmark method, sliding displacement, exterioir deformation

Hydraulic design methods for outlet facilities installed tunnel inside

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: Dam Hydraulic Engineering

Author: KASHIWAI Josuke
MIYAWAKI Chiharu
OGURO Maki

Abstract:
In order to promote effective use of existing dams, additional installations of outlet facilities seem to be increase. Additional facility is installed inside of a tunnel if there is not sufficient space for it in a dam body, and rational design methods of this kind of facilities are required. Goals of this investigation are to elucidate the hydraulic characteristics and phenomena of air entrainment, and to propose design methods of tunnel dimension and air supply system. 2004 fiscal year is the first year of the investigation, the relationships between flow situations and physical parameters concerning tunnel dimension and flow were examined through model tests. Pressure characteristics inside of the tunnel were also examined. Circle tunnels and outlets were used in the tests without air supply system.

Key words: outlet facility, tunnel, air entrainment, hydraulic model test, Weber number

Investigation of effective use of low quality fine aggregate for dam concrete

Budged: Grants for operating expenses
River account
Research Period: FY2003-2005
Research Team: Structure Management Technology
Author: KAWANO Hirotaka
KATAHIRA Hiroshi

Abstract:
This study's purpose is to propose the effective use technology of low quality fine aggregate for dam concrete.

The following results are obtained from the experiments using several kinds of fine aggregates. When low quality fine aggregate was used in concrete,

1) Slump value dropped ,consequently unit water increased to keep workability.
2) Compressive strength was not decreased.
3) Little degradation of durability against to freeze-and-thawing action was observed.

Key words: low quality fine aggregate, fresh properties of concrete, compressive strength, freeze-thaw resistance

Rationalization of mechanical design on dam rock foundation under complicated geological condition

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
TOMIDA Naoki
SATO Hiroyuki
NAKAMURA Yousuke

Abstract:
In this fiscal year, we investigated of the scattering of the nonlinear deformability evaluated by per-forming high precision triaxial compression testing for undisturbed specimens of soft rocks. In addition, the effects of the scattering of the deformation modulus of rock foundations on the assessment of the settlement of the foundation surface and strain in the elongation direction due to the construction of an embankment dam was carried out with stochastic deformation analysis.

Key words: dam, rock foundation, soft rock, nonlinear deformability, scattering

A study on geotechnical evaluation of loosened rock-mass for dam foundation

Budged: Grants for operating expenses
River account
Research Period: FY1999-2005
Research Team: Geology
Author: SASAKI Yasuhito
KURAHASHI Toshiyuki

Abstract:
This paper described the geotechnical evaluation of loosened rock-mass for dam foundation. We divided loosened rock-masses into three types, and showed six indicators as followed. 1) Rock-mass classification based on observation, 2) width of open fracture, 3) continuity of fracture, 4) density, 5) Elastic costant or velocity of P-wave, 6) coefficient permeability. These indicators revealed the loosened zone in the Tertiary bedrock in the abutment of dam site.

Key words: dam foundation, loosened rock-mass, indicator

Research on rational design and construction method of dam foundation grouting

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
SATO Hiroyuki
NAKAMURA Yousuke

Abstract:
Considering the preservation of environment and the safety of dams, it is necessary to investigate rational and economical grouting design and construction method under the complicated geological condition.

In this study, we have continued the research on (1) possibility of omission of check holes, (2) rational hole layout of consolidation grouting and (3) influences of permeability distribution on underseepage considering spatial correlation. We found that (1) check holes could have the possibility to be omitted but surrounding conditions should be carefully considered, (2) both grid patter and line pattern of hole layout of consolidation grouting have advantages and disadvantages, and (3) spatial distribution of permeability has greatly influences on underseepage.

Key words: dam, grouting, final-order hole, check hole, seepage analysis

－Priority Research Project－

Research on reducing construction costs of super-long highway structures

Research Period: FY2002-2005
Project Leader: Director of Structures Research Group
SATO Hiroshi
Research Group: Earthquake Disaster Prevention Research Group
Road Technology Research Group
Structures Research Group

Abstract:
To improve living standards, cities and regions should jointly own resources and functions. Technologies have been required to build low-cost super long highway structures which will connect regions that are separated by straits. In this priority research project, the following technologies and methods are being developed: Earthquake resistant design methods for new types of towers and foundations, wind resistant superstructures of suspension bridges, thin pavement, open grating floor deck and tunnel design methods with tunnel boring machines.

Key words: super long highway structures, bridges, tunnels, cost reduction, earthquake, wind

－Individual Themes－

Study on rational design and construction method of substructure for super long span bridges (1)

Budged: Grants for operating expenses
Road account
Research Period: FY1998-2005
Research Team: Foundation Engineering
Author: FUKUI Jiro
ISHIDA Masahiro

Abstract:
In the investigation for the new traffic axes in Japan, it is required to make bridge foundation smaller and to cut down the cost of construction. The purpose of this research is development of new bridge foundation types, such as piled-foundations or considering suction effects.

In 2004, calculations by Finite Element Method were performed to the experiments of piled-foundations. The moment-curvature line of calculations fit to that of experiments within small settlement. Centrifuge experiments were performed to confirm suction effects. The suction effect is shown on sand and effective under the alternative displacement.

Key words: piled-foundation, suction effect, model experiments

Study on rational design and construction method of substructure for super long span bridges (2)

Budged: Grants for operating expenses
Road account
Research Period: FY1998-2005
Research Team: Ground Vibration
Author: SUGITA Hideki
KONDOH Masuo
TANIMOTO Shunsuke

Abstract:
For the construction of channel-connecting highways, the rationalization of design and construction method of the bridge foundation is required. This study aims to propose new type foundation such as piled foundation for the super long-span bridges. By this study, it became clear that residual horizontal displacement decreased, when the penetration is established in the foundation. It became clear that residual vertical displacement and vertical response displacement during earthquake were suppressed by making to be piled foundation.

Key words: bridge foundation, piled foundation, centrifuge test, dynamic response, residual displacement

Development of seismic design method for long-span bridges against large-scale earthquakes

Budged: Grants for operating expenses
Road account
Research Period: FY1998-2005
Research Team: Earthquake Engineering
Author: UNJOH Shigeki
ENDO Kazuo

Abstract:
This study has explored the reasonable seismic design method for a long-span suspension bridge against large-scale earthquakes. Seismic performance evaluation method for a RC tower and a steel tower had been proposed by identifying the limit states and damage progress characteristics so far. In this year, the strength and ductility characteristics of a CFT (Concrete-Filled Steel Tube) tower, which was proposed as a new type of suspension bridge tower in last year, were studied through pushover analyses. In addition, nonlinear force-displacement relationship and damage progress of the CFT tower with enlargement of the diagonal members and installation of shear links were characterized. Based on the studies, a seismic performance evaluation method for the CFT tower was proposed.

Key words: long-span suspension bridge, CFT tower, seismic performance evaluation, pushover analysis

Research on superstructures of super long-span bridges with good economical efficiency and aerodynamic stability

Budged: Grants for operating expenses
Road account
Research Period: FY1999-2005
Research Team: Bridge Structure
Author: MURAKOSHI Jun
FUMOTO Koichiro
INAGAKI Yukiko

Abstract:
To improve living standards, cities and regions should jointly own resources and functions. Super long road structures should be built to connect regions that are separated by straits. Technologies are being developed to build low-cost super long road structures.

One of the most important subjects in designing long-span bridges is to ensure aerodynamic stability. Based on the results of the wind tunnel tests of a whole bridge model, a cable-stayed suspension bridge with combination of slottedbox girder and boxgirder has been proposed to ensure aerodynamic stability.

Structural analysis on 3 different types of cable system and wind tunnel test of a 1/125 full scale bridge model were conducted. Based on the results, it is found mono-duo type cable system has good aerodynamic stability.

Key words: super-long bridge, aerodynamic stability, cable-stayed suspension bridge, cable system