－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 unnecessarily 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 outputs in the project period (fiscal year 2002 -2005) are given in the below.

1) For river-crossing bridges with abutments, a seismic capacity assessment methodology for bridge piers was newly developed that take into account the confinement effect of abutments and their backfill soils against girder seismic displacement.

2) For low-rise wall-type bridge piers, it was confirmed that the deep beam effect can be taken into account up to a response ductility ratio of around 1.5; as such piers generally show the deep beam effect against shear bearing capacity in transversal direction.

3) Several seismic retrofit methods that require no additional strengthening of bridge piers were developed.

4) A displacement-based seismic design procedure for river dyke on liquefiable sandy ground was developed.

5) Empirical settlement prediction method for road embankment on liquefiable sandy ground was developed.

6) Countermeasures to road embankment settlement due to liquefaction of foundation ground and their design procedure were proposed.

7) A displacement-based seismic design procedure for pipes buried in liquefiable backfill soils was developed.

8) Specifications for countermeasures to uplift of buried pipes due to liquefaction of

backfill soil are proposed.

Key words: existing engineering structures, seismic stability assessment, seismic reinforcement, level-2 earthquake, cost-performance

－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 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. A seismic design procedure which limits the displacement response of whole bridge systems with abutment is proposed and some methods are introduced. The evaluation for backfill soil of bridge abutment is studied from the results of the loading test for an actual bridge abutment in US. Then 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. It should be noted that "The examples of the seismic retrofit methods for existing bridges" based on this study is published. Furthermore, the policy for seismic retrofit of mid to long span bridges and particular bridges were summarized.

Key words: existing bridges, seismic retrofit, total bridge system, shear capacity, displacement constraint method, abutment, the examples of the seismic retrofit methods for existing bridges, long span bridges, damage analysis, simplified damage evaluation method

Rationalisation of liquefaction remediation techniques for river dike foundation

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

Abstract:
Purpose of this project is to rationalise liquefaction remediation techniques and their design methods for river dike foundation. Findings obtained from physical model tests and numerical analyses in the project form the conclusion as follows:
1) Mechanism of liquefaction-induced settlement of river dikes was identified with a series of centrifuge model tests and empirical permanent settlement prediction method for river dikes is proposed.
2) Simple dynamic analysis methods for settlement prediction of river dike whose liquefiable foundation is remedied by several techniques are proposed and are implemented in the draft of design manual for liquefaction remediation for river dike foundation.
3) Scope of application of the settlement prediction methods mentioned above is extended to the super levee and the method is implemented in the draft of super levee design manual.

Key words: liquefaction, earthquake retrofit, ground improvement, settlement assessment

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:
After Hyogoken-Nanbu earthquake, improvement of seismic performance of earth structure, for example embankment, has been needed. More economical seismic countermeasures are needed because the countermeasures cost very much. The purpose of the study is to propose rational design method and economical seismic countermeasures for road embankment. In this study, 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. The followings were found:
1)A simplified method to predict embankment settlement based on the deformation mechanisms was proposed.
2)Effects of each countermeasure and synergy effects of some different countermeasures were cleared.
3)A simplified method to predict settlement of embankment with remedial measures and a design method for remedial measures to reduce liquefaction-induced embankment settlement were proposed.

Key words: road embankment, liquefaction, earthquake, 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:
Major cause of damage to sewage structures is soil liquefaction. Remedial measure techniques for soil liquefaction have been needed. The purpose of the study is to propose a rational design method and economical seismic countermeasures for sewage treatment facilities and sewer pipes during soil liquefaction.

In this study, a performance based design method for remedial measures for soil liquefaction, a prediction method of unequal settlements due to soil liquefaction between sewage treatment facilities and connecting pipe, prediction method of liquefaction-induced damage to sewer pipes and its measures were studied. The followings were found:

1) A performance based design method for sheet piling method for sewage treatment facilities during soil liquefaction was proposed.
2) A prediction method of unequal settlements due to soil liquefaction between sewage treatment facilities and connecting pipes was proposed.
3) Prediction methods of liquefaction-induced damage to sewer pipes based on geomorphologic classification map were proposed.
4) Specifications of backfill soil for remedial measures for backfill soil liquefaction were proposed.

Key words: sewage treatment facilities, liquefaction, countermeasure, centrifuge model test, uplift

－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
TERADA Hideki
Research Group: Material and Geotechnical Engineering Research Group
Erosion and Sediment Control Research Group

Abstract:
The progress of developing of counter measures for minimizing the damage caused by natural disaster and for preventing secondary disaster are required in addition to construction of facilities for disaster prevention, to protect nation's lives and properties from debris flow and slope collapse caused by heavy rainfall, earthquake, volcanic eruption.

Therefore the method to evaluate the hazard level, design and arrange slope stabilization works adequately, research and monitor slope condition using the latest technique, manage the hazard of slope adjacent to road are developed to protect residential area and road from disaster in this research.

The achievement of this research are shown as below,

1) The method to predict hazard area and make comprehensive hazard map are developed.

2) The optimum method to design and arrange slope stabilization work using numerical analyzing are developed.

3) The method of research and monitoring of slope using GIS and IT, and method of risk management of slope adjacent to road are developed.

Key words: debris flow, slope collapse, hazard map, piling work, monitoring, risk management

－Individual Themes－

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: KURIHARA Junichi
YAMAKOSHI Takao

Abstract:
Deposition of tephra changed the hydrologic properties of the river basins around the volcano and intensified erosion processes, and hydrological characteristics of watersheds changes through volcanic activity.
A purpose of this study is to propose the evaluation method of the potential of lahar occurrence in the volcanically disturbed watersheds, which consists of the evaluation method of the hydrograph of lahar and the estimation method of sediment volume based on research of hydrologic and erosion conditions at the watersheds affected by tephra. In this study, post-eruption hydrological and erosion properties at the Miyakejima volcano are clarified through field hydrologic measurements and the integrated basin-wide prediction model of water and sediment discharge are developed. In addition, gully development process is clarified. Through these knowledge and analysis, the evaluation method of the potential of lahar occurrence and estimation method of sediment volume was proposed.

Key words: volcanic eruption, volcanic ash, hydrograph of lahar, estimation method of sediment volume, Miyakejima Island

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: KURIHARA Junichi
AKIYAMA Kazuya

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 areas accurately in urban area, since the mechanism of mudflow inundation in urban area is complicated under the influence of structures such as buildings, roads and bended flow channel.

In this study, numerical experiment was conducted to make the simulation model of sedimentation and inundation, under the condition of complicated shape of the land, accurate by using unstructured grids. In addition, a technique of making hazard map for mudflow by using GIS, and a technique of designing the countermeasure facilities were suggested.

Key words: mudflow inundation, sedimentation, hydraulics model experiment, 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
ISHII Yasuo

Abstract:
To mitigate the landslide disaster damage, it is important to prepare the hazard map by extracting the landslide area and evaluating the landslide risk properly. On this study, we examined an automatic landslide extraction algorithm by digital elevation model and a risk assessment method of potential landslide sites by applying the correlation analysis to landslide records and results of potential landslide site investigation. As a result of these, we showed possibility of automatic landslide extraction for typical landslide topography by the algorithm that combined picking out landslide distribution by topographical features of 'Gradient, Lapracean, Unevenness' and 'Gradient, overground-openness, underground-openness' and picking out landslide boundary by 'convex break of slope, convex change of slop'. In addition, we showed possibility to improve method of the landslide risk assessment by revised score of investigation items of 'Landslide sign' and 'Landslide history', 'Landslide topography' that has a relatively high correlation with landslide occurred site.

Key words: digital elevation model, risk assessment, correlation 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:
Standard formulae for designing landslide restraint piles in Japan are selected based on assessment of factors such as stability and mechanical characteristics of the ground that supports the piles. However, the interaction between earth and pile is not fully regarded in deriving the standard design formulae. In this study, we made a FEM model firstly to estimate the interaction between landslide and the piles. Based on the result of the FEM analysis, we propose range to apply the design formula for landslide pile. Secondly, we studied the stability of landslide mass between the piles by centrifuge model experiment. And the stability of landslide mass between piles was also simulated and analyzed by the FEM model. Thirdly we studied pile works design method by 3-D FEM. As a result of that, the following was clarified.
1) When $\beta \cdot l$, which is calculated by modulus of deformation of landslide soil mass and the pile bending stiffness, becomes three or less, the moment obtained by finite element analysis becomes bigger than that obtained by pile design formula of wedge pile.
2) When the pile interval becomes wider, the shear strain in the landslide soil mass between piles becomes bigger. Maximum pile interval can be estimated based on the shear strain rising.
3) We developed 3-D FEM method to design the piling works. The method is useful to arrange the piling works position, and it is reasonable way to reduce the cost of the countermeasures.

Key words: landslide, pile works, finite element method, pile interval, pile works design method

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
KURAHASHI Toshiyuki
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 areas. We also developed hazard area estimation methods, as follows:
1) Fragility analysis of failure area in disaster area caused by heavy rain
2) Hazard area estimation programs based on landslide simulation using GIS system
3) Shallow Landslide Simulation System (SLSS)
4) Hazard area estimation system for rock mass failure (HES)

Key words: road slope, hazard map, risk management, hazard area estimation

Development of road slope evaluation techniques using road disaster prevention map

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

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
KATOU Shunji
MASUYA Yugo

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 geological survey technique and hazard mapping for rock-mass 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 rock-mass slope failure. We published a manual of air-tracer testing, and proposed that logging detects fractured zone inside of rock slope. Besides, 3-D laser mirror scanner and GIS software precisely delineated slope feature for hazard mapping, and velocity structure estimated from 3-D seismic diffraction tomography delineated fractured zone on a rock-mass.

Key words: rock-mass slope, fractured zone, air-tracer testing, logging, 3-D seismic diffraction tomography

Study on the investigation, measurement 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 examined the methods for identifying unstable rock blocks by measuring micro-tremors and vibration on rock slopes, and was analyzed as follows.
1) Micro-tremors of rock block were measured while the rock block was made unstable intentionally. The result indicated that the vibration level became bigger when the rock block became unstable.
2) Based on the results of vibration measurement at a rock slope, stable rock blocks and unstable brocks were distinguished, and especially unstable brocks were identified.
3) Re-observation of rock slope based on the measurement results revealed some cracks separating the blocks into several micro blocks and these micro blocks vibrate separately.
4) Results of micro-tremors and vibration measurement at a rock slope in which the countermeasure (adhesion of rock blocks) was carried out were analyzed, and change of vibration after the countermeasure was revealed clearly. These results suggest that the vibration measurement will be one of useful methods to estimate the independent rock blocks and also suggest that the micro-tremors and vibration measurement will be a useful method to judge the effect of countermeasures. A technical manual for this measurement and analysis technique was edited based on the above results.

Key words: rock slope, micro-tremors, vibration

nvestigation of landslide movement by optical fiber sensor

Budged: Grants for operating expenses
River account
Research Period: FY2002-2005
Research Team: Snow Avalanche and
Landslide Research Center
Author: HANAOKA Masaaki
MARUYAMA Kiyoteru
KOJIMA Shin-ichi

Abstract:
For understanding the landslide behavior which are important to prevent and mitigate landslide hazards, there are two essential subjects in the nowadays most effective extensometers:
1) It is difficult to properly set the extensometer while the landslide behavior is not so significant;
2) It is difficult to measure the earth surface in snow season. For these problems, we has been studying and developing the investigating methods for surface behavior of landslide by using optical fiber.

For the 1) we directly buried the optical fiber by using gridding method, and for the 2), we developed an extensometer by combination with other mechanical tools. And we achieved useful results that could be used in actual landslide sites.

Key words: optical fiber sensor, landslide movement investigation

－Priority Research Project－

Study on evaluation of water quality risk in water evaluation

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, and investigations were carried out for five years;

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

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

－Individual Themes－

Behavior of chemicals from urban discharge in water evaluation

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

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 2005, we conducted development of analytical techniques of natural estrogens and nonylphenol (NP) and its derivatives (NPs) in sediment and activated sludge samples. And adsorption isotherms of NP and NPs in lake water were obtained using the batch equilibrium method.

Key words: NP, NPEO, NPEC, estrogens, sediment, activated sludge, adsorption isotherm

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 FY2005, behavior of free estrogen, their conjugates and synthetic estrogen (oral contraceptive pill) in wastewater treatment plants was investigated using batch biodegradation experiments.

Main results are as follows;

1) Behavior of free estrogens and estrogen sulfates in batch biodegradation experiments simulating municipal wastewater treatment process was studied. Dissolved free estrogens were removed under high DO concentration (>3.0mg/L), while they were not decreased under low DO concentration (<0.5mg/L). This result indicates that estrogen reduction rate depends on the DO concentration.

2) Behavior of free estrogens and estrogen sulfates in batch biodegradation experiments using aeration tank effluent was studied. Dissolved free estrogens were increased under anoxic condition. This result indicates that behavior of dissolved free estrogen depends on the DO concentration at the end of aeration tank and final sedimentation tank.

Key words: endocrine disrupting chemical, estrogen, municipal wastewater treatment, aeration tank, dissolved oxygen concentration

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:
Feminization fish has been paid attention in rivers receiving treated wastewaters in Japan. Therefore, the effect of treated wastewater on the fish feminization and methods to evaluate the effects were studied using in vivo assay (Japanese medaka), in vitro assay (DNA recombinant yeast which has human estrogen receptor) and instrumental chemical analysis of endocrine disrupter and estrogens in treated wastewaters and river waters.

Key words: estrogen-like substances, sewage treatment plant, 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
TOYAMA Akiko

Abstract:
The aim of this study is to adapt techniques of molecular biology (particularly the PCR method) to pathogen detection to develop a rapid and highly sensitive method for detecting trace levels of pathogenic microorganisms in natural water, treated wastewater and sludge. The study focused on the Cryptosporidium and virus.

In FY2005, we investigated the adaptability of pre-treatment of the sewage to increase the collection rate of the oocyst to detect the Cryptosporidium with PCR method. As for virus detection, we evaluated the reverse transcription efficiency of the virus gene extracted from the thickened sample to improve the detection sensitivity of the virus.

Key words: Cryptosporidium, virus, detection method, PCR, natural water, wastewater, sludge

－Priority Research Project－

Research on techniques for conserving ground evaluation

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: ground environment, heavy metals, organic chlorine compounds, dioxins

－Individual Themes－

A study on environmental safety of construction materials

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.

We studied the behavior of dissolution of environmental endocrine disruptors from ground materials used in construction works.

Moreover, the adsorption and desorption behavior with some kind of soils of solved-out environmental endocrine disruptors was studied. We also proposed the idea on the safety of environmental endocrine, disruptors from ground materials.

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
MASUYA Yugo

Abstract:
An evaluation method for soil materials is essential to ensure environmental safety of construction material. In this research, an environmental effect of hexavalent chromium leached from cement treated soil and simplified leaching method of lead and arsenic for soil material was researched.

From the results of researches, it was concluded as follows;

1) types of soil and cement agent affect on leaching value of hexavalent chromium,

2) hexavalent chromium leached from cement treated soil has low potential of diffusion to surrounding soil,

3) characteristic of leaching of lead and arsenic for simplified leaching test was observed.

Key words: cement treated soil, simplified leaching test, hexavalent chromium, lead, arsenic

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:
The aim of this study is to establish the evaluation method regarding the exudation of heavy metals and acidic water from specific rocks. Using waste rock samples, we carried out some leaching tests and chemical analyses under various conditions. The result of this study is summarized as follows; 1) The risk map for the heavy metal pollution in Japan has been developed. It will be useful for the evaluation of heavy metal pollution risk. 2) The X-ray fluorescence spectrometric analysis (XRF) can be effectively used as a simplified method to evaluate the pollution risk caused by the waste rocks. 3) Elution properties of heavy metals from varied rocks are systematically related to the type of acid of solvent, the acidity of solvent and the character of the element. 4) Pollution risk of the exudation of acidic water can be estimate by the content and the form of sulfur and calcium in the rocks. 5) A long-term elution test under the conditions similar to these in natural environment has been designed in this research project. 6) A provisional manual for the exudation of heavy metals from specific rocks has been developed.

Key words: waste rock, heavy metals, acidic water, pollution risk, leaching test

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

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

Abstract:
There occasionally exist soil and groundwater contamination in construction sites. A permanent countermeasure, such as decontamination, is desirable, but from time and economical reason the containment method is more suitable in actual. In this research, the evaluation method with a convective diffusion analysis, containment method and monitoring method has been developed.

In this research, the behavior of the contaminants in the ground is studied and the evaluation method for impact of the soil and groundwater contamination is proposed. In addition, we settle a basic idea for an inspection and countermeasure for soil and ground water contamination and the manual for soil and groundwater contamination in construction site has been published.

We'll precede the research to build an effective management method for soil and groundwater contamination.

Key words: soil contamination, investigation, impact evaluation, management method, monitoring

－Priority Research Project－

Research on comprehensive hydrologic model for river basins

Research Period: FY2001-2005
Project Leader: Director of Water-related Hazard Research Group
TERAKAWA Akira
Research Group: Water Environment Research Group
Water-related Hazard 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－

Study on integrated hydrological models and its verification

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: Hydrologic Engineering
Author: FUKAMI Kazuhiko
INOMATA Hironori

Abstract:
Recently, many hydrological models have been developed in many countries. But, there have been no technical references that show which hydrological models should be selected and applied to interested watersheds. In this study, a technical reference which enables river engineers to select a hydrological model to an interested watershed effectively was finally summarized. Hydrological models were classified and arranged by practical views such as thearea and the characteristics of watersheds, the objective of their application, etc. in the technical reference. Two methods to identify objectively and quantitatively which hydrologic model is most rigorous and stable were also proposed in the technical reference, that is, the Jackknife method and the Monte Carlo method. The two methods for checking the stability of hydrologic models were verified through an application to an experimental basin.In addition to that, hydrological database was designed and set up to meet the needs to examine hydrologic models as described above.

Key Words: hydrological model, stability checking method, technical reference, hydrological database

Study 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:
Ensuring low flow discharge is proposed as one of the objectives in the recovery plan for water circulation system in basin. For that purpose, a tool which can analyze how much low flow management alternatives like water effective utilization, re-distribution or change of water utilization rule affect river flow condition is required. In this study, two analytical methods were developed and verified for the Yasu River which is one of the rivers flowing into the Biwa Lake as a case study. One of them, WEP model, estimates how much change of water utilization at farm land affects river flow and the other one, PWRI-distributed hydrologic model (Ver.3), estimates how much forest condition affects to river flow condition. In addition to that, a low flow management system, RiverWare developed by the US Bureau of Reclamation, which utilizes the two analysis methods described above was proposed and verified in the same target area.The simulation results of both WEP model and PWRI Distributed Model Version.3 show high applicability. In the RiverWare simulation, dam operation rules and artificial water intake were input with the unique interface implemented in RiverWare. The simulation result showed not only the high applicability to a Japanese river basin but also the high operability of RiverWare.

Key Words: low flow management, water balance in agricultural watershed Area, hydrologic system in forest-covered watershed area, basin-wide hydrologic 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
TSUSHIMA Koji

Abstract:
Stable isotope ratios of carbon and nitrogen were determined for nitrate, particulate organic matter (POM), periphyton, aquatic insects and fishes in three research rivers. The first purpose of this report is to estimate the ecological functions of temporal water area around river channel by fishes. Carbon stable isotope ratio of genus Carassius fishes (Carassius spp.) was confirmed that the fishes that were hatched and grown in those water areas returned to main river channel. Carbon isotope ratio of Oikawa fishes (Zacco Platypus) has shown that some individuals which had lived in the river channel moved to the water areas for refuge during a flood event. The second purpose is to estimate the influence of Kawamata Dam on river ecosystem in the downstream sites. Survey results showed that organic matter discharged from the dam influenced food web at the downstream site. The third is to estimate the effects of experimental flood (flush discharge) on periphyton on the river bed at the downstream of Mayagase Dam. Periphyton in middle-section of our study area was scraped and it supplied most POM to the river. However, some of the POM seemed to settle down at further downstream. Relative magnitude of flush discharge is less fierce at the downstream because the discharge volume is almost the same along the downstream of the river until another branch or main stream merges. Flowrate for flush discharge should be estimated by considering pick-up and sedimentation of periphyton at the river bed throughout the downstream.

Key words : stable isotope ratio, river ecosystem, temporal water area, particulate organic matter

－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
NAKAMURA Keigo
DENDA Masatoshi
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 2005 fiscal year, we studied about the long-term trend of the riparian land cover, the aim and method of cutting the high water beds and the method of keeping gravel and sandy riverbeds. We have shown how vegetated area has been increasing since 1990 and suggested the way of maintaining gravel and sandy riverbeds.

Key words: anthropogenic impact, ecological response, river, the promotion of nature restoration

A fundamental survey on environmental flow involving natural regime

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: Aqua Restoration Research Center
Author: 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 2005 is as follows:
1) Effect of artificially flushing flow on substratum adhesion due to benthos inhabitation in downstream of Managawa dam

In the gravel river below Managawa dam, substratum adhesion was investigated by using simple equipment made from a drag rake and a spring scale. The field investigations were carried out in two types of channel geomorphic units in the reach, before and after flushing from the dam. According to the results, the strength of substratum adhesion which was caused by the inhabitation of benthic invertebrates was changed not with the flushing, but with the variation of geomorphic units.
2) Effects of artificially flushing flow on periphyton in downstream of Miyagase dam

On 22 Feb. and 15 Oct. 2005, the discharge from the dam was increased to a maximum of 100 m3s-1 from 2 or15 m3s-1 and then decreased to 2.1 m3s-1. We conducted the surveys 0.8km and 2.5km approximately downstream the dam, and we analyzed chl.a and ss in river water. Periphyton were collected from several channel units (riffles both with and without sediment supplies from a small tributary, run and stream edge without sediment supplies). At the run, the stream edge, and the riffle with sediment supplies, decrease in algal biomass (chl.a and cell density) were observed, whereas difference was not observed at the riffle without sediment supplies. Chl.a in river water hit a peak when the discharge got to about 30-40m3/s. Therefore, we advanced a suggestion that the flush peak discharge of artificially flushing flow to decrease periphyton were about 30-40m3/s.

Key words: flow regime, restoration, periphyton, benthos, artificially flushing flow

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 about 20m. We carried out an demonstration experiment in Chikuma river. We succeeded in tracking fish behavior for about six month period, which contains floods. Fish behavior data was analyzed and it showed that home range of the fish was 4,000 ㎡ in average . During floods, a test fish acts corresponding to the distribution of velocity to avoid being flushed out. The result of the experiment shows that ATS has enough ability for tracking fish behavior in ordinary and flood period. This suggests that ATS is a useful tool for researching fish behavior and its preference.

Key words: Telemetry, automatic fish positioning system, home range, fish behavior in floods

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
OISHI Tetsuya

Abstract:
Paddy field area is important as a habitat of fishes, and as a spawning ground of several fishes who live in rivers. In recent years, the stream between river and paddy field area are divided for the convenience of water management. In this research, the influence for fish caused by division of river and paddy field area was investigated. Restoration of the water-network around river and a paddy field area was also considered and the cost index of ecological network(CIEN) was proposed to compare the suitability of restoration plans.

Key words: stream network, a paddy field, temporary water area, fishes habitation environment, cost index of ecological network

－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 quality control technologies of reservoirs, numerical simulation model for estimating water temperature and turbidity in reservoir was produced, operation methods of selective withdrawal facilities for releasing inflow temperature were examined and efficiency of curtain system for reducing the influence of turbid water releasing was examined. Concerning the sediment control technologies, characteristics of sedimentation in Japan were observed, estimation methods of each size sediment volume inflow related with water discharge was developed, numerical simulation model for realizing sedimentation profile and riverbed change in river downstream was produced, characteristics of sediment supply by sediment bypassing/flushing operation from the view point of relation with released water discharge rate were examined, estimation methods of abrasion quantities of sediment transport hydraulic facilities were developed and idea of lining plan was proposed. With regard to the river restoration technologies, initial erosion condition and process of fine deposited sediment was examined, test facility for algae separation was proposed, hydraulic characteristics of the facility was examined and condition of the requirement of flushing operation was examined.

Key words: dam reservoir, water quality, sedimentation, river restration

－Individual Themes－

Abrasion of sediment transport channel by sand and gravel

Budged: Grants for operating expenses
River account
Research Period: FY2003-2005
Research Team: River and Dam Hydraulic Engineering
Author: KASHIWAI Josuke
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. Items of the study are examination of estimation methods for abrasion quantities that can apply various shapes of hydraulic facilities, finding relationship between abrasion quantity and abrasion load quantity of lining materials especially for concrete, development of abrasion test machine for the concrete lining materials and examination of planning methods for lining hydraulic structures. Concerning the estimation methods of abrasion, hydraulic model test was employed.

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: River and 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. In this investigation, in order to elucidate supplied sediment behaviors mainly concerning the flushing process of resettled sediment or draw down sediment flushing process during a flood, as follows examinations were carried out. The characteristics of resettling sediment scouring were examined by physical model test and numerical simulation using plane two-dimensional movable bed model developed in this study. In order to predict the downstream riverbed variation, the one-dimensional movable bed model was developed and the setting methods of upstream boundary condition were examined. The characteristics of behavior of supplied sediment by the sediment flushing were also analyzed by the one-dimensional model. Based on the above mentioned results, the impact of supplied sediment behaviors on downstream riverbed formation was examined in the viewpoint of sediment discharge property.

Key words: sediment management, sedimentation, sediment flushing, sediment resettlement, erosion, sediment discharge

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

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. Items of the investigation were hydraulic experiments for the erosion condition of deposited fine sediment, design of the test facility for algae separation, hydraulic experiments for ascertaining the hydraulic characteristics of the facility, examinations for the flushing operation requirement and examinations for saving methods of the water storage capacity for flushing.

Key words: flushing operation, fine sediment, algae-reproduction

－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
SAKANOI Kazuyuki
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

－Individual Themes－

Transport of nutrients through sediment-water interface

Budged: Grants for operating expenses
River account
Research Period: FY2001-2005
Research Team: Water Quality
Author: SUZUKI Yutaka
ABE Chika

Abstract:
The aim of this study is to clarify the release mechanisms of nutrients form lake and reservoir sediments from the viewpoint of eutrophication countermeasures and propose a technique to estimate the rate of nutrient release. The following investigation was carried out through experiments targeting the lake and reservoir sediment from FY 2002 to FY 2005. (1)Evaluation of the influence of dissolved oxygen of the bottom layer water on the nutrient concentration of the pore water in the sediment. (2)Evaluation of the influence of long time oxygen supply to the bottom layer water on the sediment condition. (3)Calculation of nutrient release rates using monitoring data. (4)Evaluation of the influence of disturbance to the sediment surface on the nutrient release mechanism through laboratory experiment.

key words: sediment, nutrients, release rate, 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. The research results in FY2005 were as follows.
1) Inflow rivers, water channels, air depositions and sediments can presumably be classified as load sources with different watershed or emission source characteristics.
2) PAHs loads flowing into waters seemed to contain not only air deposition PAHs emitted from combustion, but also PAHs derived from oil spills transported by road runoff in wet weather.
3) The load from air deposition PAHs in the soluble fraction were larger than in the particle fraction when benzene rings of the PAHs were smaller than 4 and vice verse when they were 5 or more. BaP load by direct air deposition on the lake surface was estimated to be 14% of the total BaP load flowing into the lake.
4) It is assumed that because BaP concentration in outflow rivers was higher than in inflow rivers in dry weather, BaP that flowed in and settled was lifted from the bottom and re-suspended , but the volume of transportation was estimated to not be large enough to equalize the concentration distribution in all areas of the lake 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
TOKIOKA Toshikazu

Abstract:
Suppression effect on bottom sediments resuspension by aquatic macrophyte Trapa in Inba marsh was shown by field measurement and numerical simulation. While vegetation was dense, turbidity measured inside of it was lower because of the wave attenuation by vegetation. Suppressed resuspension by vegetation will enhance the irradiance at the bottom of the marsh. This will improve the chance for submersed macrophytes to survive. If we can rehabilitate submersed macrophytes to Inba marsh, they will keep suitable environment by themselves. Improving light condition will be the key to the rehabilitation of submersed macrophytes. Also investigated was the distribution of density of propagule in lake bottom sediment and the germination potential of propagule in Kasumigaura. We have shown that the densely distributed propagule was found in the vicinity of the river mouths and bays. Germination tests for sediment samples taken from several depths showed that the density of propagule was high at the depth of 40-50cm from sediment surface, and the number of germination of aquatic macrophytes was high at the depth of 30-40cm from sediment surface. Age determination of the bottom sediment showed that these layers of sediment correspond to the sediment which was accumulated during period when submerged plants were dominant in the lake.

Key words: bottom sediments, submerged plants, propagule bank, age determination

Performance of the artificial lagoon to control diffuse pollutants

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

Abstract:
The term, “artificial lagoon (AL)” means an artificially constructed small lake or pond at a river mouth in a lake. The AL aims to control diffuse pollutants of the river flowing into a lake. The first AL was installed in 1998 at the river mouth of the Kawajiri River flowing into Lake Kasumigaura in Japan; Four ALs have been constructed until now. This paper compares the performance of the four ALs. The removal ratio calculated the percentage of deposit load in the AL by inflow load was 6.8~46 % for CODMn, 1.6~27 % for total nitrogen, and 8.2~87 % for total phosphorous. The load rate (g/m2/day) estimated by the inflow load per area per day explains the removal ratio the best. The load rate is the most crucial factor to design AL. We also compare the performance of AL with that of constructed wetlands. The annual performance of AL exhibits similar results of that of constructed wetlands.

Key words: nonpoint source, stormwater treatment wetland, lake, pollution, constructed wetland

－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－

A study on life extention for pavement

Budged: Grants for operating expenses
Road account
Research Period: FY1998-2005
Research Team: Pavement
Author: KUBO Kazuyuki
YABU Masayuki
SAKAMOTO Yasufumi
TERADA Masaru
TANIGUCHI Satoshi

Abstract:
This paper analyses results from past investigations of test pavements to propose a method for evaluation of pavement fatigue resistance, a method for evaluation of pavement serviceability and structures for longer life pavements. The analysis shows that the initial deflection of the surface is a good indicator for pavement fatigue resistance while the qualities of materials used and the deflection of the road surface are good indicators for pavement serviceability. It is also shown that pavements designed with enlarged TA and composite pavements have longer lives.

Key words: long life pavement, resistance of fatigue, serviceability, performance, sustainability

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 FY2005, 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.

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

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 this research, an analytical model for simulating dynamic bridge response by truck running was proposed, and it was clarified analytical results roughly agree with experimental results on a test bridge in PWRI. As for countermeasures to reduce traffic-induce vibration at expansion-joint, focusing on extended concrete decks, the structural details were proposed considering durability and maintenanceability. The effects of the extended decks on reducing traffic-induce vibration were clarified by field measurements before and after experimental construction at a site.

Key words: traffic-induced vibration, countermeasure to reduce vibration, extended deck system

－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－

Study on soundness check and reinforcement of existing ground anchor

Budged: Grants for operating expenses
Road account
Research Period: FY2002-2005
Research Team: ConstructionTechnology
Author: OSHITA Takeshi
ONODERA Seiichi

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 this study, 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. And based on the test and investigation results of past few years, the draft of “Manual for inspection, soundness tests and repair of ground anchor” was prepared.

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

Survey of the improvement of steel bridge repainting technologies

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

Abstract:
Steel bridges are social infrastructure whose durability is assured by painting. The paint film protects the steel structure from corrosion. In order to maintain a good paint film condition, it is necessary to repaint them appropriately after a certain stipulated period. The durability of the paint film is determined by the corrosion resistance of the coating material and substrate surface quality. The surface preparation is said to have a particularly great impact on the repainting of an existing steel bridge. Therefore, the theme of this research was surface preparation technologies for steel bridge repainting.

In order to perform the maintenance interval more efficiently, problems were clarified through a actual condition survey. Then, we studied appropriate surface preparation for heavy duty coating system (fluoro resin paint). The heavy duty coating system has effect on improvement of paint film durability and to preserve the environment. We focused on the quantity of adhering salt that has a great impact on deterioration of the paint film, and studied about the acceptable value for surface preparation and the procedure to reduce that quantity below the acceptable value. And then, the life cycle cost (LCC) in a case where this procedure was applied was obtained and compared with that of the conventional procedure.

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:
Repainting is indispensable for steel bridges. Increase of infrastructures requires to reduce the maintenance cost for repainting. Hence, it is important to study the extension of repainting intervals with excellent paints in durability. In this study, the performance and durability of new paints which can reduce the painting cost are evaluated. Efficient painting methods for the cost reduction were also developed.

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

－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

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: new materials, untapped materials, recycled materials, high-strength steel re-bar, fiber reinforced plastic, non-standard aggregates, organic wastes, other industrial wastes

－Individual Themes－

A study on application of FRP to road infrastructures

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

Abstract:
This study focused on the possible applicability of FRP to plate girder pedestrian bridges as anti-corrosive structural members. The findings are that the specification for steel road bridges modifying the deflection limit and the evaluation of bucking strength can be applied as a design method for FRP pedestrian bridges, the built-up FRP main beam can be used as well as the unit beam and that the clamping force is more important for FRP bolted joints than steel.

Key words: FRP, plate girder pedestrian bridge, design method, built-up FRP main beam, bolted joints

Development of effective use technology of recycled aggregate and low quality aggregate

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

Abstract:
This study's purpose is a proposal of effective use technology of recycled aggregate and low quality aggregate in concrete.

The following results are obtained from the experiment using recycled aggregate :
1) Durability performance against freezing-thawing action of concrete with recycled aggregate is greatly affected by air content of mother concrete from which recycled aggregate is produced.
2) Improvement of devices to produce recycled aggregate or mix properties of recycled aggregate concrete have little effect on the performance of recycled aggregate concrete.
3) We have developed a simplified test method to assess recycled aggregate performance against freezing-thawing action.

The relationship between aggregate property, such as weight loss measured by soundness test for aggregate, and freezing-thawing durability of concrete was not necessary clear. This means new evaluation method for aggregates performance should be developed.

key words: recycled aggregate, freeze-thaw resistance, test method, freezer, low quality aggregate

Recycling of organic wastes by utilizing bio-solids treatment system

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

Abstract:
Large quantities of wood wastes and grasses are produced during civil engineering works and maintenance of green sites. This study aims to develop and offer the technologies of effective use of these organic wastes, especially wood wastes, by utilizing bio-solids in the wastewater treatment plants.

The anaerobic co-digestion, the acid fermentation, the composting, the sludge conditioning and the processing revegetation material were examined.

It was developed that the anaerobic co-digestion of bio-solids and steam-exploded woods and the composting of digested bio-solids slurry. The ground woods was a good quality conditioner for the dewatering process of bio-solids slurry, and the compost of steam-exploded woods which was made from addition of bio-solids had the same quality as peat moss for a using revegetation. The experiments on the acid fermentation of wood wastes indicated that wood waste could be the source of acetate production but the fermentaion didn't stable, there is need to more research and study. The studies on the composting of bio-solids slurry and the acid fermentation of wood wastes were analyzed 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, wood waste, bio-solid, anaerobic digestion, acid fermentation, composting, sludge dewatering, revegetation material

Recycle technology of industrial waste materials

Budged: Grants for operating expenses
General account
Research Period: FY2001-2005
Research Team: Material and Geotechnical Engineering Research Group
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 first published “Technical Guideline on Recycle Product of Industrial Waste Materials”. We also researched the economic evaluation factors for recycle products and applied them to waste shell which is not recognized as a useful ingredient in the guideline. We finally concluded that waste shell could be replaced by fine aggregate for prefabricate concrete product.

Key words: industrial waste material, recycle, construction industry, technical guideline, waste shell, aggregate, concrete product

－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－

Hydraulic design methods for outlet facilities installed tunnel inside

Budged: Grants for operating expenses
River account
Research Period: FY2004-2005
Research Team: River and Dam Hydraulic Engineering
Author: KASHIWAI Josuke
MIYAWAKI Chiharu

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. Items of the investigation are flow conditions in a tunnel, pressure reduction at the upstream end of a tunnel without air supply system, influence of model scale on above phenomena, effect of air supply system on the pressure reduction phenomena and methods for deciding tunnel section and air supply system. These items were examined through hydraulic model experiments using one outlet and uniform section tunnel model. Influences of two outlets and contacted tunnel section were also investigated.

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

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

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

Abstract:
This research project is carried out to propose the effective use technology of low quality fine aggregates for dam concrete.

The following results are obtained from the experimental study with using several kinds of fine aggregates.

When low quality fine aggregate was used in concrete,

1) Unit water increased to obtain required workability, however this obstacle is possible to be overcome by effective use of concrete admixture.

2) Compressive strength and durability against freeze-and-thawing action was not affected.

3) Little degradation of durability against freeze-and-thawing action was observed.

Based on the above result, we have proposed tentative advice notes for the use of fine aggregate which does not satisfy quality requirement in the current standard specification for concrete dam construction.

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

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
SATO Hiroyuki
TOMIDA Naoki
NAKAMURA Yousuke

Abstract:
In this fiscal year, we investigated the scattering of the nonlinear deformability parameters evaluated by performing 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. We finally summarized the results of the four-year research on “rationalization of mechanical design on dam rock foundation under complicated geological condition”.

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

A study on geotechnical evaluation of a 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, which is fractured and faulted with open fractures. We collected 196 dam foundations in loosened rock-masses all over Japan. Geotechnical analysis and grouping lead to clarify the mechanism and characterized a loosened rock-mass. Variety of rock property values such as P-wave velocity, density and sum of fracture width were useful as quantitative indicators for loosening.

Key words: dam foundation, loosened rock-mass, open fracture, 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 fiscal year, we have continued the research on (1) rational permeability evaluation for high permeable zone, (2) correlation between Lugeon values and other physical/geological data and (3) possibility of omission of check holes. Because this fiscal year is the last year of this research, we also conclude our research results in the past five years as well as the results in this year.

Keywords: dam, grouting, check hole, high permeable zone

－Priority Research Project－

Research on reducing construction costs of super-long highway structures

Research Period: FY2002-2005
Project Leader: Director of Structures Research Group
FUKUI Jiro
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 bridge (1)

Budged: Grants for operating expenses
Road account
Research Period: FY1998-2005
Research Team: Foundation Engineering
Author: NAKATANI Shoichi
TAKEGUCHI 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 type, such as piled-foundation or considering suction effects.

In 2005, analysis shows that estimate equation for bearing force increment of piled foundation are proposed. The suction effects on sandy ground are verified by model experiments using centrifugal loading apparatus, and suction effect depending on water height and advantages of skirt water-stop for suction effect are confirmed.

Key words: suction effect, piled-foundation, skirt water-stop, model experiments

Study on rational design and construction method of substructures for super long span bridges

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. In this study, it was clarified that piled foundation decreases residual displacement of foundation. A simple dynamic analysis method was proposed and it was clarified that the method can reproduce residual displacement by using resistance value of ground and piles in conventional design criteria.

Key words: bridge foundation, piled foundation, centrifuge test, dynamic analysis, 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 with emphasis on a tower against a large-scale earthquake. Pushover analyses of 3 types of tower, steel, RC and CFT (Concrete Filled Tube) towers, were performed to evaluate the force vs. displacement relationships and the damage characteristics. Nonlinear dynamic analyses were also conducted to investigate the compatibility of static pushover analyses to dynamic responses. Based on these results, a seismic performance evaluation method for superstructures of a long-span suspension bridge was proposed.

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

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

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

Abstract:
One of the most important subjects in designing long-span bridges is to ensure aerodynamic stability. Structural analysis on 2 different types of cable system and wind tunnel test of a 1/125 full scale bridge model were conducted. Based on the results, a cable-stayed suspension bridge, which applies mono-duo type cable system with combination of slotted box girder and box girder, were proposed to ensure aerodynamic stability.

Also, wheel running tests of full-scale models of open grid decks with different structural details were carried out to investigate the fatigue durability. Based on the results of fatigue life estimation, structural details were proposed from the point of view of fatigue resistance for practical use.

Key words: super-long bridge, aerodynamic stability, cable-stayed suspension bridge, open grid steel deck, fatigue, wheel running test